JUNE 28, 1954

Electrical World

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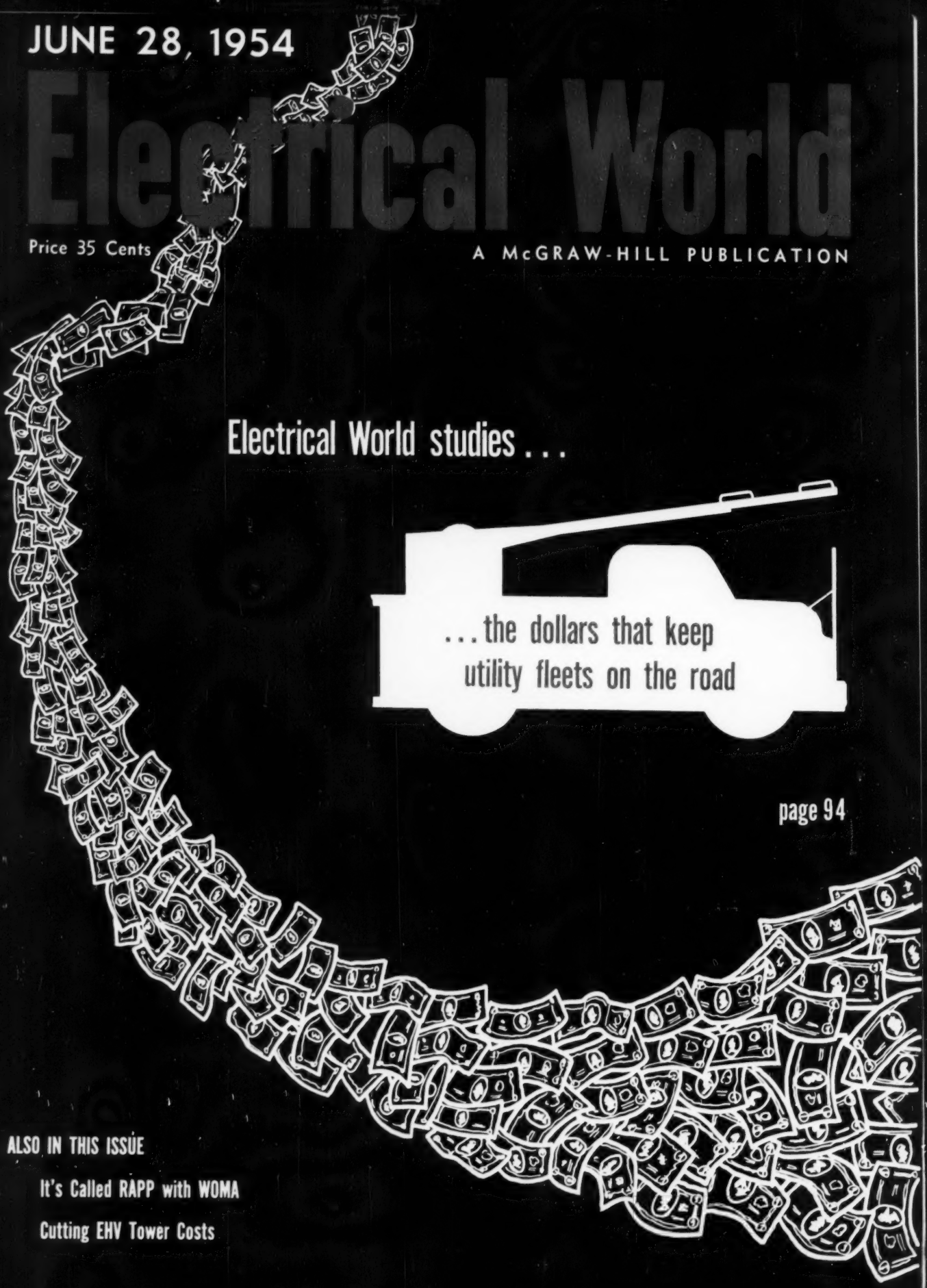

Electrical World studies . . .

. . . the dollars that keep utility fleets on the road

page 94

ALSO IN THIS ISSUE

It's Called RAPP with WOMA

Cutting EHV Tower Costs

MORE THAN 10 TIMES AS OXIDATION-RESISTANT

TESTS PROVE that *Texaco Regal Oil R&O has more than ten times the oxidation-resistance* of ordinary turbine oils. That's why, in actual turbine service, it has far superior ability to prevent sludge, rust and foam.

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This Issue's Highlights

P. L. Bellaschi, who wrote the article on electrical clearances for higher voltage transmission lines on page 104, is a Portland, Ore., consulting engineer.

AIEE Fellow . . . Since graduating from Massachusetts Institute of Technology, Bellaschi has engaged in work devoted to station, line and distribution equipment development. In addition to covering America, Bellaschi's consulting work takes him to Canada, Europe, and South America. One of the laurels he has won during his engineering career is a fellowship in the American Institute of Electrical Engineering.

P. L. BELLASCHI

Automotive Survey . . . This issue of Electrical World contains a nationwide automotive survey designed to examine utility "auto" operating costs. Fifty-seven utilities participated in the poll.

Two years in the making, the survey on page 94 includes these pertinent facts: Cost per mile, big expense items like gas and oil, repairs, and depreciation, average mileage per vehicle, fleet replacement, and fleet size.

On a mileage cost basis, the survey analyzes variations in cost from passenger cars to heavy trucks. Areawise, it also shows the difference in operation between urban and rural utilities. Figures on fleet replacement and fleet growth are included, too.

Company policies on preventive maintenance and driver training programs were also polled.

Jabberwocky . . . Electrical World is not entering the "land of Jabberwocky" when it offers the article entitled "It's Called RAPP with WOMA —The Missing Link." Instead Electrical World readers will learn all about Arizona Public Service Co's new convenience to its customers and employees by turning to page 110.

Electrical World

Published for 80 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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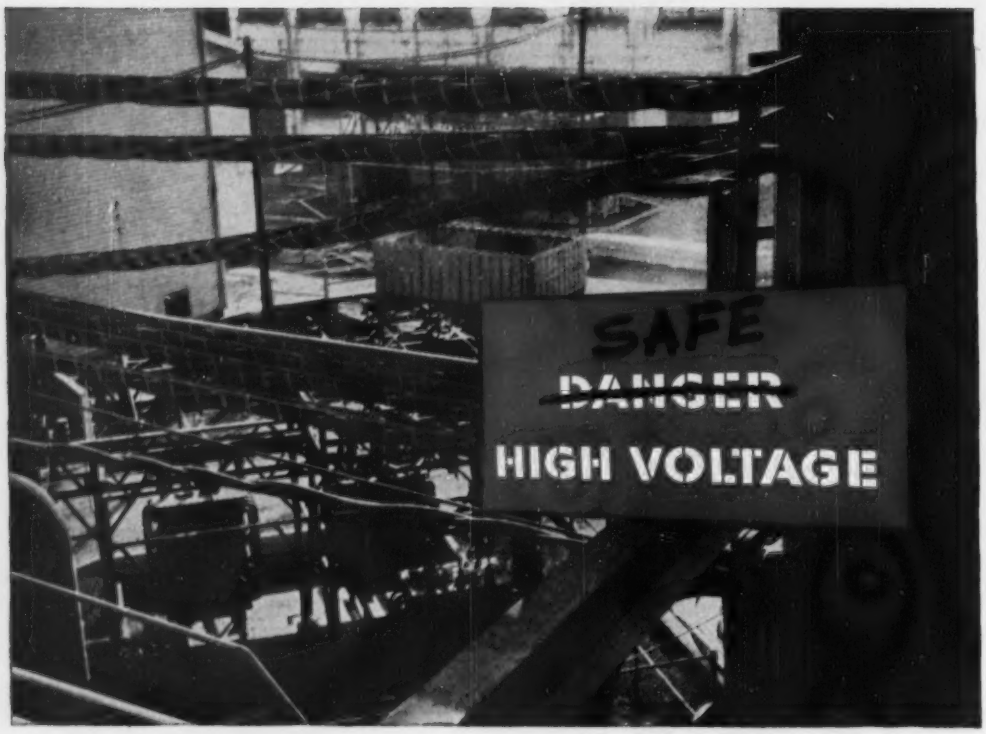

SPACE SAVED, INSTALLATION COSTS CUT BY OKOLITE-OKOPRENE SELF-SUPPORTING AERIAL CABLES

Okolite-Okoprene self-supporting aerial cables enabled the Weyerhaeuser Timber Company to use existing plant structures as cable supports at their mill in Longview, Washington. The savings in space, in addition to economies made possible by eliminating poles and expensive duct systems, are significant reasons for the increasing use of self-supporting cables.

Okolite-Okoprene cables are advantageous for use in industrial applications because the Okoprene sheath is unharmed by weather extremes or the caustic acids, sulphides and sulphates common to these areas. The cables also present an unusually neat appearance and provide improved voltage regulation. Longer spans, simple installation techniques and reliability in storms have made Okolite-Okoprene self-supporting cables the logical choice for economical, long-lasting service.

Write for Bulletin EW-1074, which contains full information, including installation recommendations, on self-supporting cables. The Okonite Company, Passaic, N. J.

OKONITE insulated cables

2207

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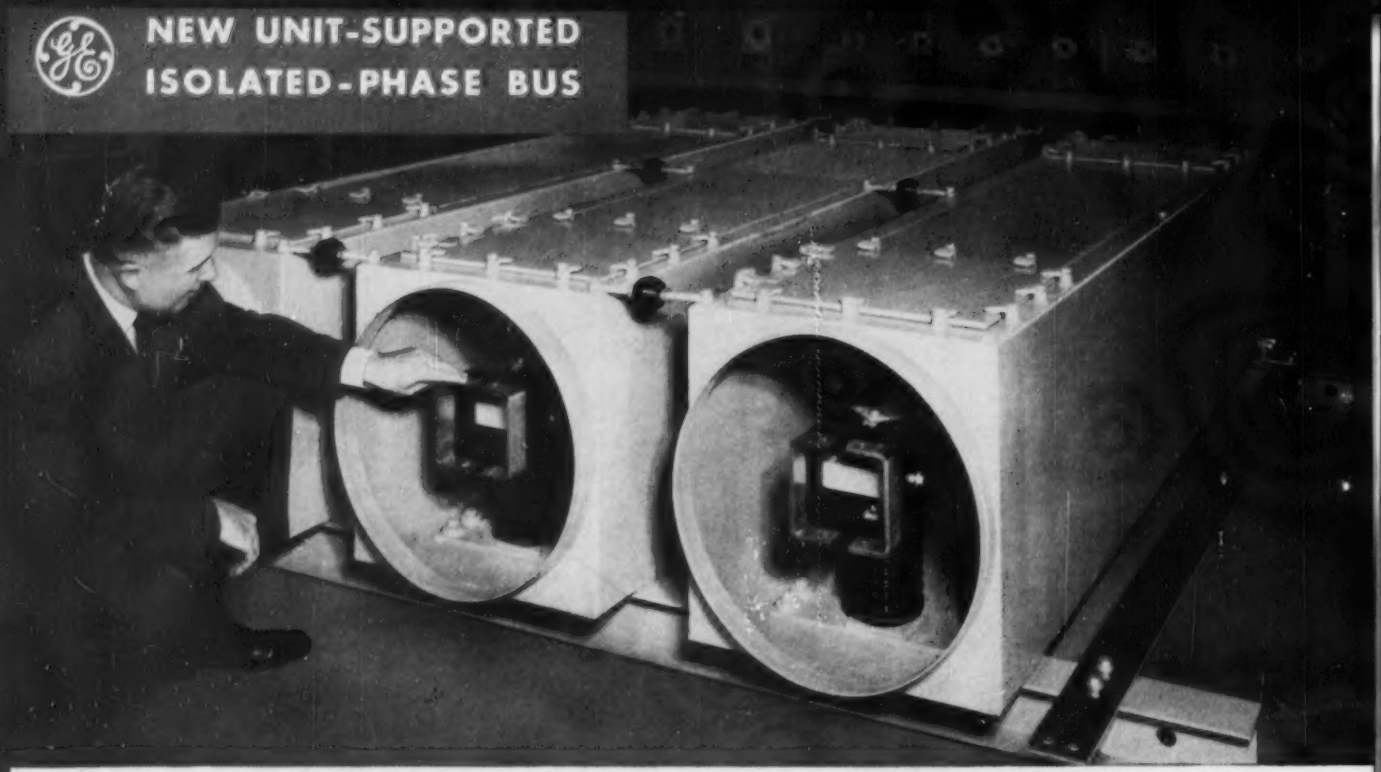
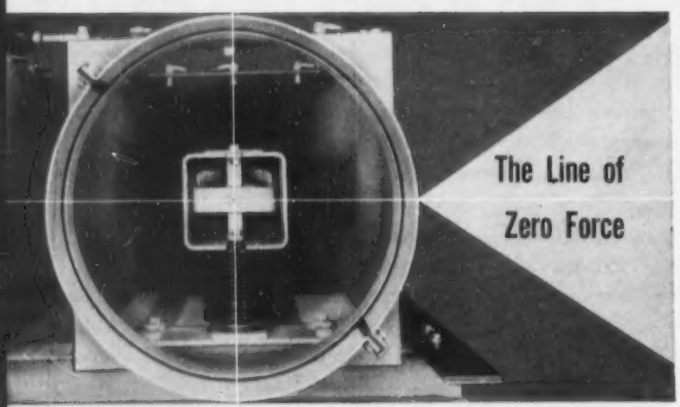


NEW UNIT-SUPPORTED bus withstood 350,000 amperes momentary during fault-current test.

Now G.E. puts "Zero Force" to work for you



HEART OF THE "ZERO-FORCE" DESIGN is the single insulator support. It is positioned in center of conducting sheath where eddy currents help cancel fault-current stresses.

New design of isolated-phase bus reduces stress forces, needs less maintenance

General Electric's new Unit-supported, Isolated-phase Bus needs only one insulator at each support point. This minimizes the chance of insulation failure and reduces over-all weight for easier installation.

Exhaustive tests prove that ample conductor-support depends not on the number of insulators, but on their placement. G.E.'s new design places one insulator near the center of the sheath where the conductor experiences zero net force during short-circuit currents, thus enabling the bus to easily withstand fault-current stresses.

Here's how design-simplification "pays off" for you:

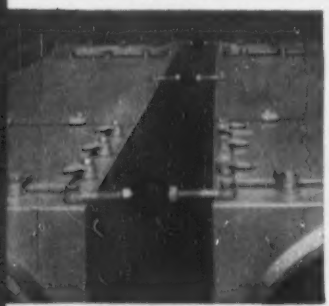
Reduced maintenance—One insulator means your inspection time is cut in half; the possibility of insulation failure minimized. Insulator-access covers are shorter, less bulky—make inspection easy.

Easier installation—New bus weighs 13% less for easier handling. There is no piecemeal assembling because you can receive completely assembled three-phase units in sections up to 16 feet long.

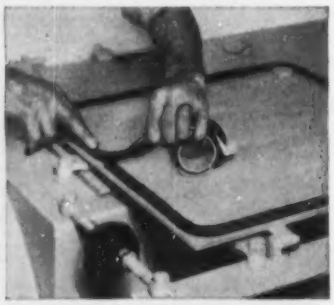
Co-ordinated design—Co-ordination with station components is an integral part of the G-E design. Phase isolation is assured in all connections with station equipments.

For more information on this stronger, lighter Isolated-phase Bus, contact your General Electric representative or write for publication GED-2237, General Electric Company, Schenectady 5, New York.

501-2

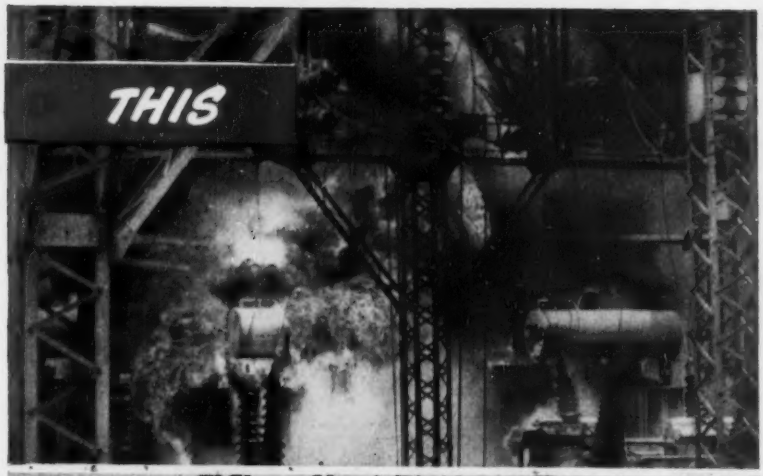


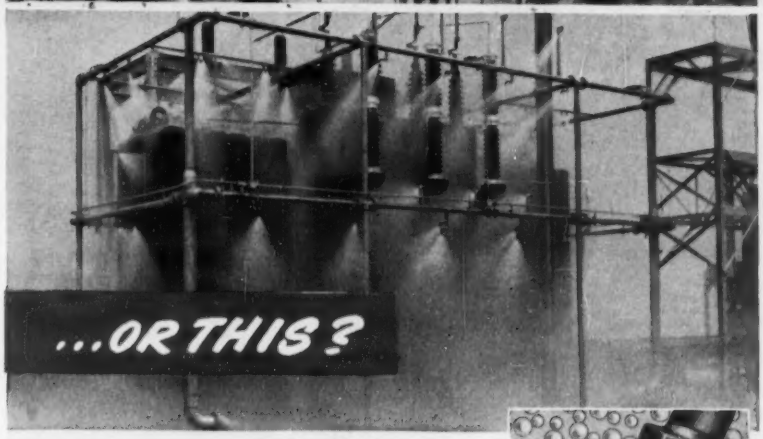
STURDY INSULATOR BRACES prevent circulating currents between housings. They are adjustable for initial lineup.

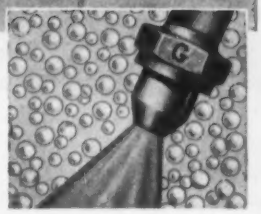


AIR-TIGHT GASKETING is accomplished with an easy-to-apply tape having a fibreflex core. Note simplified hardware on hinged cover.

GENERAL ELECTRIC







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All it ever takes, at any time, is for an arc to come in contact with oil to touch off a fire. If unchecked, as with the $50,000 blaze in the top picture, damage can be extensive.

But if there are spray projectors of a Grinnell Mulsifyre System on guard, such as those being demonstrated in the lower photograph, extinguishment usually can be obtained in a matter of seconds. In fact, the record is replete with cases of fires, occurring in oil, which fast-acting Grinnell Mulsifyre Systems have put out in quick time.

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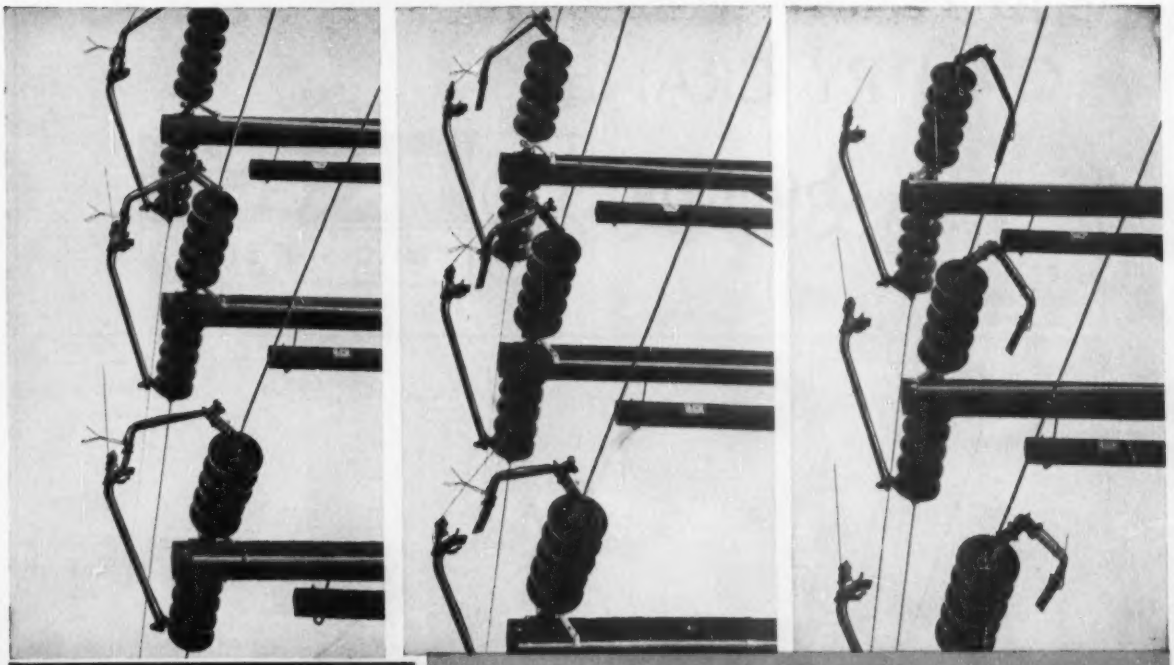
SIMPLEX WIRE & CABLE CO., 79 Sidney St., Cambridge 39, Mass.

KPF Type S switch, vertical mounted, with Quick-Break. *(Left,* switch closed. *Center,* switch opening, Quick-Break still maintaining contact, preventing arc. *Right,* KPF Quick-Break whips free in split-second, preventing establishment of arc). *Photos reproduced from September, 1949* ELECTRICAL WEST.



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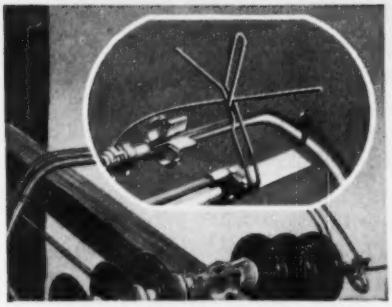
Standard for nearly half a century



The secret of the system-proved KPF Quick-Break is a heat-treated beryllium copper "cat's whisker" which whips free in a split second as the rotating arm of the switch is opened. The design and extremely high acceleration of the mechanism prevent establishment of an arc. Thus, critical arc length is not a problem. Quickly, simply installed on switches now in use.

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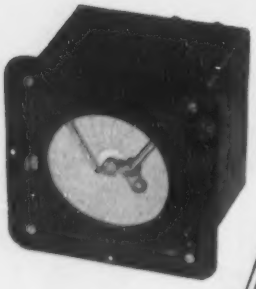
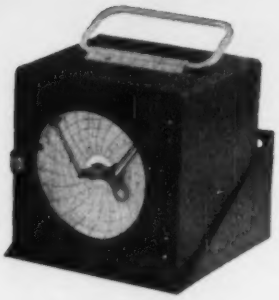


New



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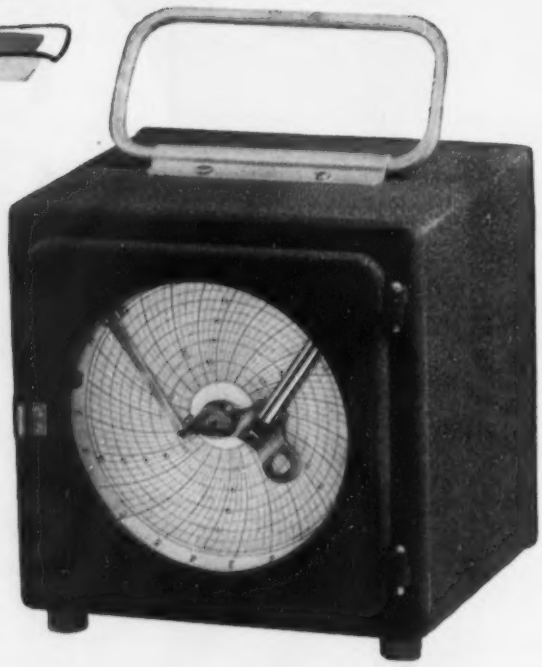

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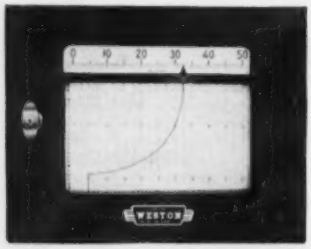

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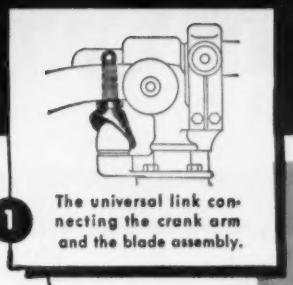
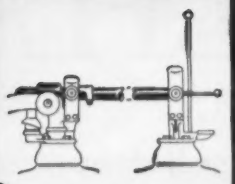
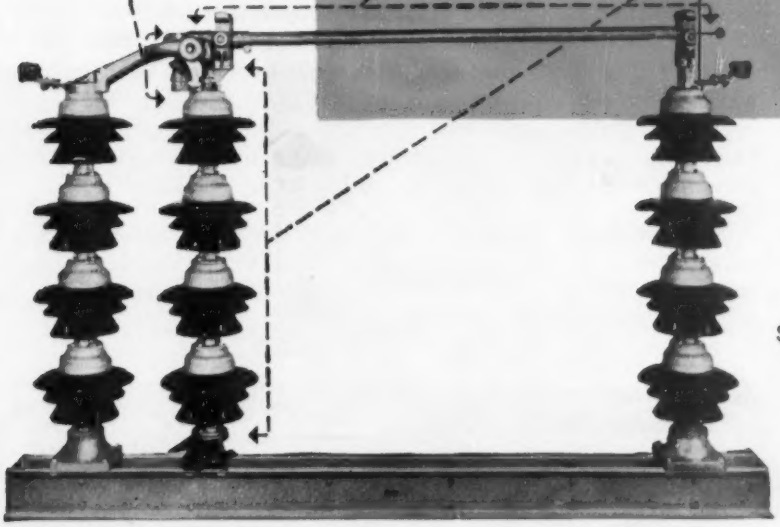


1 The universal link connecting the crank arm and the blade assembly.

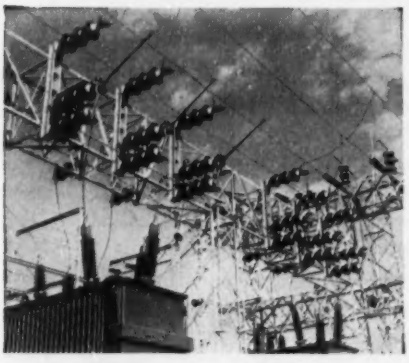


2 The blade assembly.

3 The center rotating insulator, bearing, and the crank arm affixed to the top.



AMPLITACT CONTACTS ARE AVAILABLE TO MEET UNUSUALLY HIGH SHORT CIRCUIT CURRENTS.



An extremely simple operating mechanism gives the Type WAG High Pressure Air Break Switch a superior mechanical advantage, which assures complete dependability under all climatic, operating, and atmospheric conditions—a fact proved by years of continuous service on applications in every section of the nation. The three moving elements are factory set to preclude any possibility of maladjustment.

Ease of operation, positive blade control, high contact pressure and wide contact deflection, plus a host of other outstanding features add up to unsurpassed performance and economy. Get all the facts in Bulletin 390-R, which we'll gladly send on request. Then you, too, will specify Southern States Type WAG Switches.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

Important SUPERCHARGED

Here's what operation-proved A-C development can do for you now, and in the near future

BY CUTTING GENERATOR SIZE, *supercharged* cooling permits you to reduce plant size, lower foundation and crane costs, and use smaller breakers and bus structures. Mechanical design limitations are minimized, while possible maximum ratings are raised, and field assembly problems are simplified.

Two of the *supercharged* units now in operation are shown in the accompanying photographs. The installed units and others in various stages of production utilize direct rotor conductor cooling with high-velocity hydrogen to increase the generator rating more than 70% over conventional hydrogen cooling. Backed by experience gained from the first *supercharged* units, Allis-Chalmers is now building a *completely supercharged* generator resulting in the remarkable size reduction shown on the facing page.

For basic design information and a more detailed explanation of the many advantages of this outstanding engineering development, ask your A-C representative for the latest literature on *supercharged* cooling. Or, write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4251

World's First Supercharged Unit

Installed at Wisconsin Power and Light Company's Edgewater Station in 1951, this 60,000-kw turbine-generator unit has proved the soundness of Allis-Chalmers pioneering engineering. Its excellent performance during the first two calendar years of commercial operation *(1952 and 1953)* can be summarized as follows:

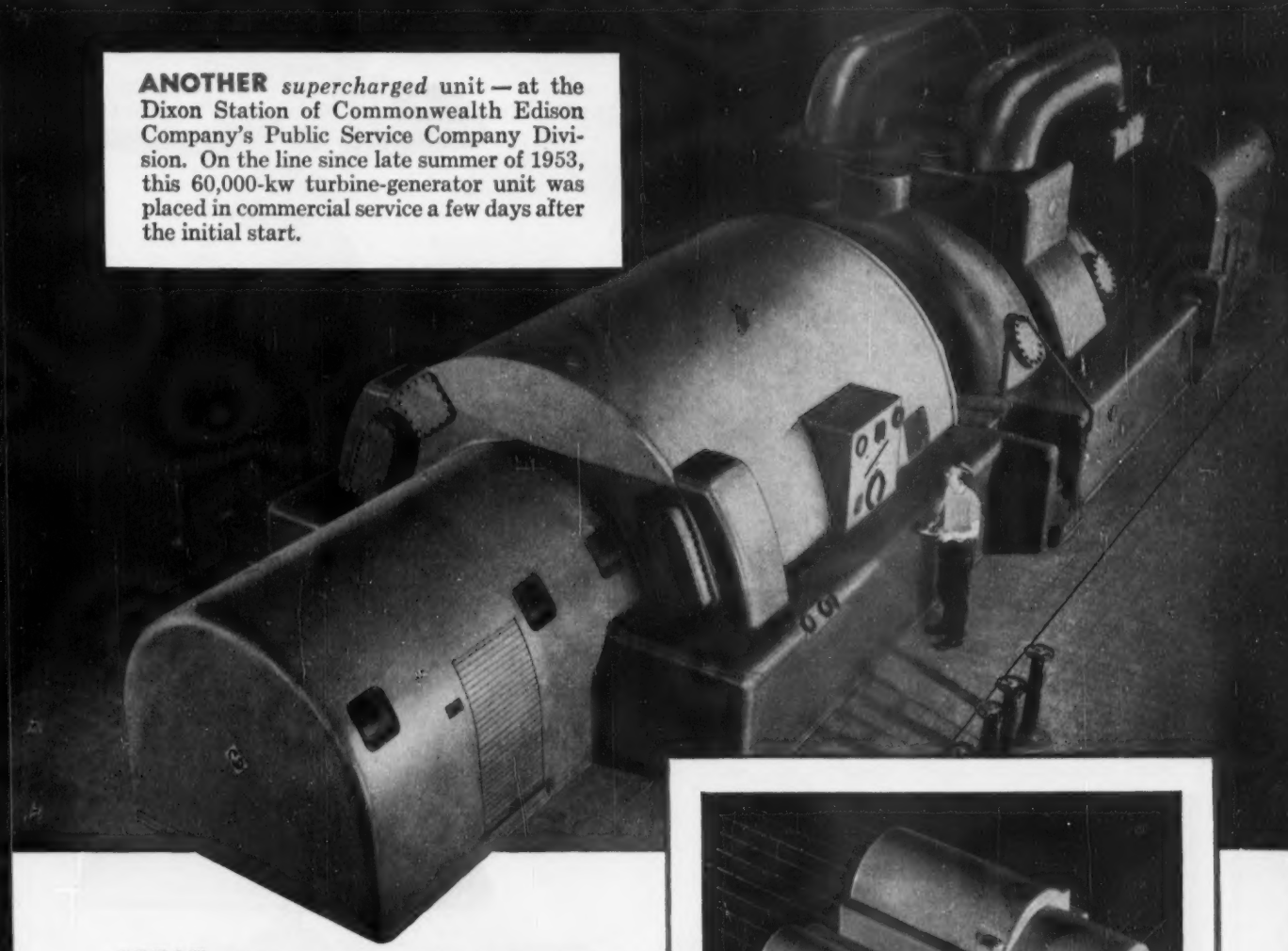
Hours in service	17,199
Service factor	98.03%
Chargeable outages	one
Availability factor	99.86%
Total generation	885,951,000 kw-hrs

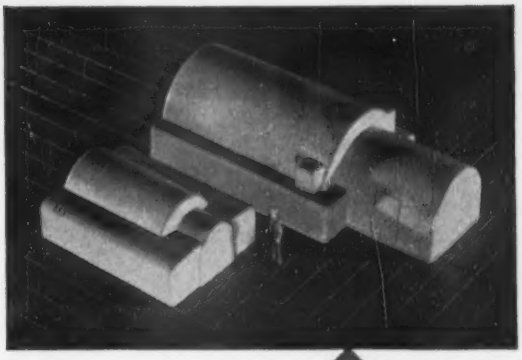
Another unit, with a *supercharged* generator but incorporating new Allis-Chalmers steam turbine design features, was placed in operation early this year at Wisconsin Power and Light Company's Rock River Station.

ALLIS-

Facts About Cooling

ANOTHER *supercharged* unit — at the Dixon Station of Commonwealth Edison Company's Public Service Company Division. On the line since late summer of 1953, this 60,000-kw turbine-generator unit was placed in commercial service a few days after the initial start.





GREAT difference in size of *fully supercharged* and standard hydrogen-cooled generators of same kw rating suggests the increased advantages full supercharging offers in power plant space, crane capacity, quantity of gas, cooling water requirements, differential expansion, shipping clearances, and many other first-cost and operating factors.

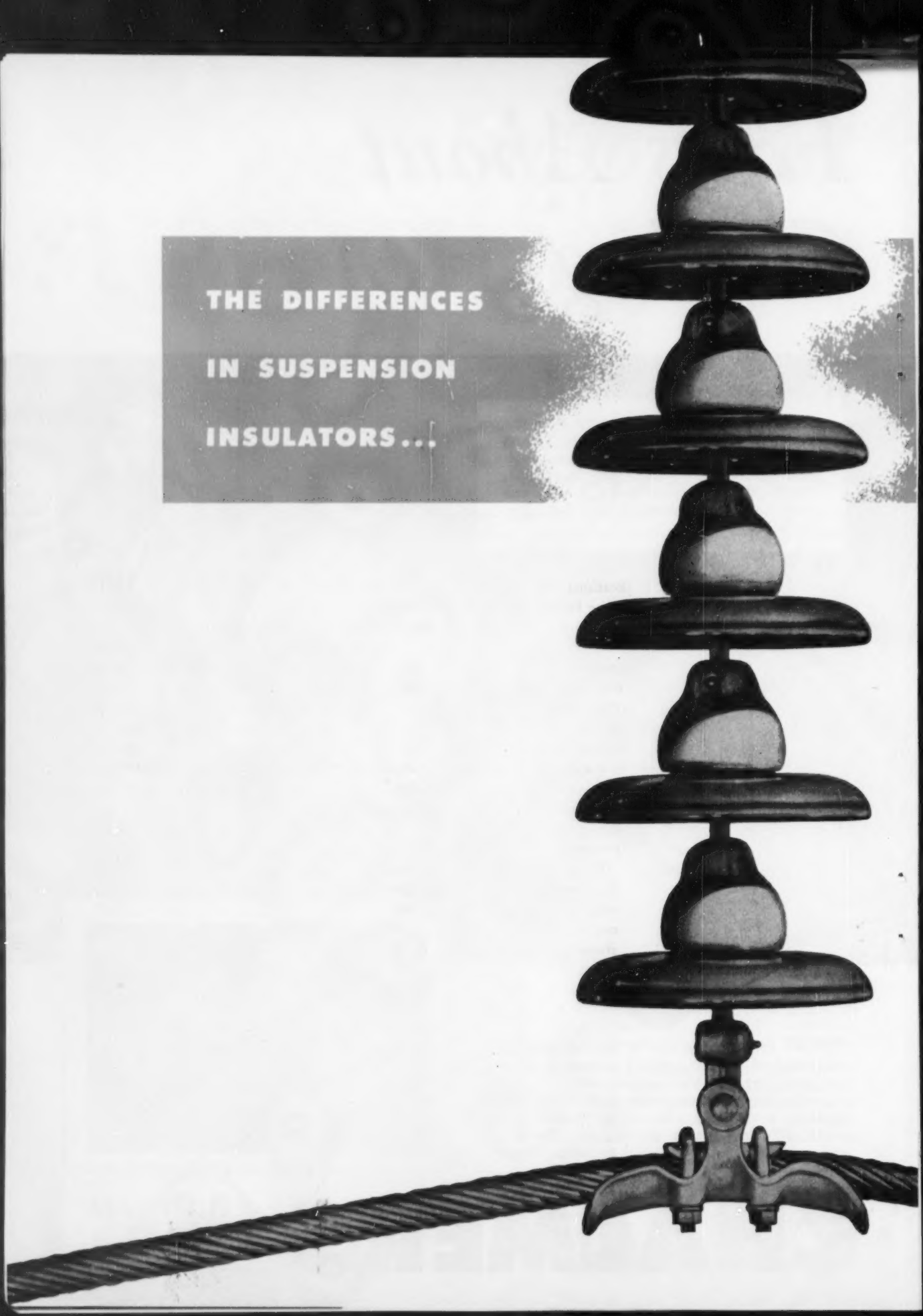
CHALMERS

A-C ALLIS-CHALMERS

THE DIFFERENCES

IN SUSPENSION

INSULATORS...



. . . ARE IN THINGS YOU DON'T SEE IN "STANDARD SPECIFICATIONS"

NEMA Standard specifications for a suspension insulator call for a disc 10" in diameter, with 11½" of leakage distance, an M & E strength of 15,000 lbs.

If that's all it takes to produce "acceptable" suspension insulators, we've wasted a great deal of money and skilled effort at Lapp! Our continuing research, development, and control programs are dedicated to the positive knowledge that *there is a difference* in suspension insulator quality—and to the end that the differences will be on the side of users of Lapp suspension insulators.

We know of the improvement in our own product we have been able to effect in 35 years. We know how trifling variables in raw materials or manufacturing procedures can result in major differences in finished product. We know that uniform electrical and mechanical characteristics of porcelain, hardware quality, and proper assembly, are not matters of chance—nor even of habit.

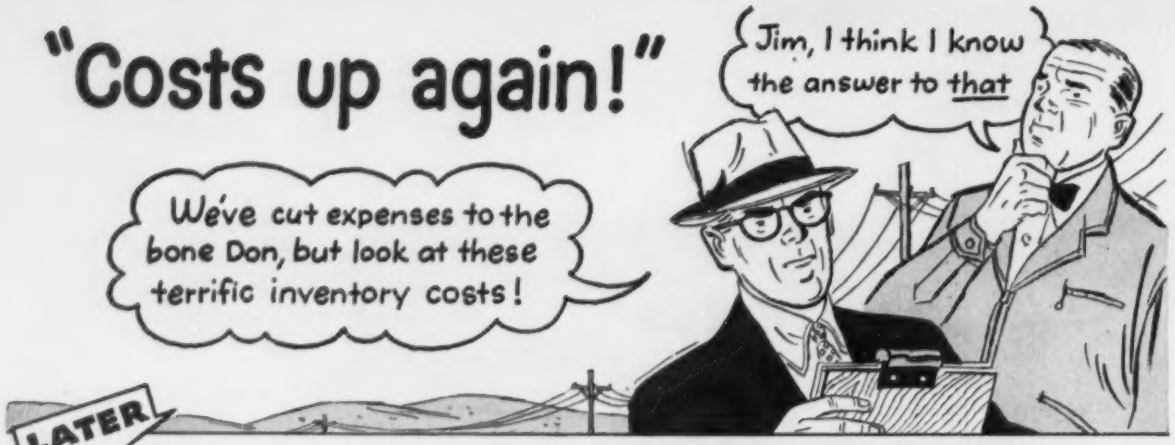
And we know, too, that after a few years of service, insulators may not have the same characteristics as when shipped from the factory. Because modern construction practices protect insulators, it is possible for lines to stay in service with a dangerous proportion of insulators which will reveal their hazardous condition only under severe electrical or mechanical emergency.

Lapp insulators are more than "good enough to meet specification." They are good enough to offer a positive extra margin of operating safety and security . . . long life . . . and low upkeep. Many of America's best transmission companies have service records to prove it is so.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

"Costs up again!"

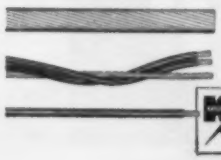

We've cut expenses to the bone Don, but look at these terrific inventory costs!
Jim, I think I know the answer to that
LATER
Meet Mr. Harris, our Kaiser Aluminum, distributor. Says he can help cut our inventory...and our costs!
That's true because you can use our inventory exactly as you use your own
WHICH MEANS...?
Which means that you can virtually eliminate your inventory..and most of the expense that goes with it!
We'll give it a try Mr. Harris. The saving is worth it!
You'll find our service valuable, too, including the famed field and engineering services of Kaiser Aluminum
We'll be glad to help solve your problems. Our long experience and Specialized knowledge is immediately available to you by a phone call. We'll give you friendly, personal attention on any size order

Kaiser Aluminum Distributors Conveniently Located to Serve You:

Line Material Co.
General Electric Supply Co.
Westinghouse Electric Supply Co.
Capital Electric Supply
Central Electric Supply Co., Inc.
Champion, Inc.
City Electric Distributors, Inc.
Corpus Christi Hardware Co., Inc.
Crescent Electric Supply Co.
Dauphin Electrical Supplies
Dutton-Lainson Co.
Electrical & Mechanical Supply Corp.
Eoff Electric Co.
Evans Electrical Supply, Inc.
Florida Electric Supply, Inc.
George H. Wahn Co.
Hampden Electric Supply Co.
Hunzicker Brothers
Interstate Electric Co. of Shreveport, Inc.
Mack Electric Supply Co.
Maydwell & Hartzell, Inc.
Nelson Electric Supply Co.
Price Electric Co.
Russell Belden Electric Co.
S. M. Supply Co., Inc.
Southern Minnesota Supply Co.
Stuart C. Irby Co.
Stubbs Electric Co.
Tafel Electric & Supply Co.
The Korsmeyer Co.
Virginian Electric, Inc.
Waltrip Electric Co.

GET IN TOUCH with your nearest Kaiser Aluminum Distributor *now*. Refer to the list at the left and your local telephone directory. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Ill.; *Executive Office*, Kaiser Bldg., Oakland 12, Calif.

Kaiser Aluminum



The Nation's Largest Supplier of Aluminum Weatherproof Conductor and Triplex

ALL RIGHT!
you make the comparison

Allis-Chalmers will ship completely free of charge to any recognized distribution system a Type JFR distribution regulator for 30 days' examination and tests. Call in your engineers, purchasing people, operating and maintenance men. Let them see for themselves why Allis-Chalmers gives your system the most for its money.

That's what an eastern utility did. All the leading makes of voltage regulators were untanked and examined. They checked designs, tested and examined for ease of installation and service. Result: in every test Allis-Chalmers distribution regulators came out on top. That's why this utility is now standardizing on Allis-Chalmers regulators.

Allis-Chalmers makes no claim you can't check for yourself. Turn the page to see some of the reasons why. Then, contact the A-C office nearest you for a regulator so that you can make your own comparison.

A-4344

ALLIS-CHALMERS

MILWAUKEE 1, WISCONSIN

ORIGINATORS OF 5/8% STEP REGULATION

A-C ALLIS-CHALMERS

Make the Untanking Test . . . See How Simple It Is to Inspect and Service This Voltage Regulator!

ALLIS-CHALMERS

5/8% STEP VOLTAGE REGULATORS

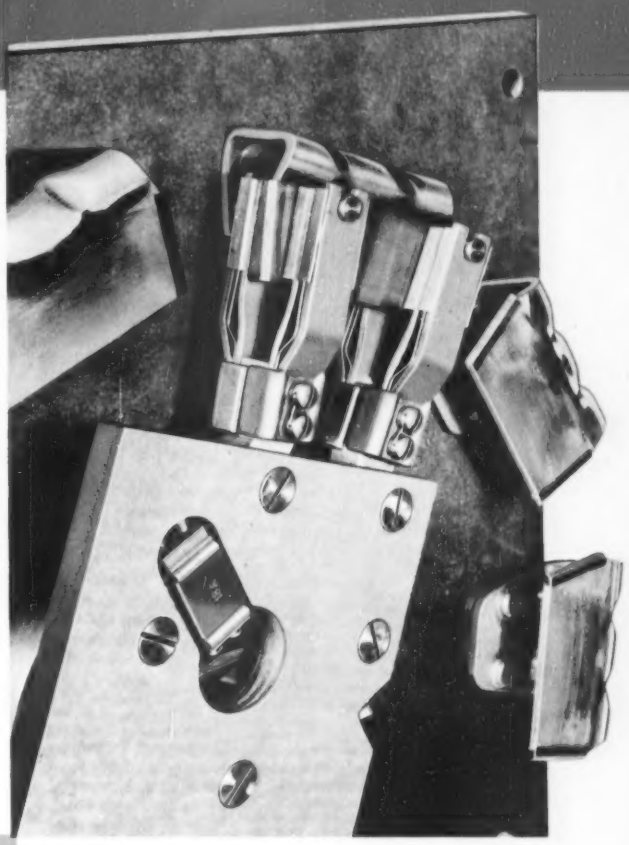
Unit construction adds dividends in workmanship. All connections are made and inspected *before* tanking. Convenient access like this means you get highest quality workmanship throughout.

First big advantage of an Allis-Chalmers distribution regulator comes when you untank it. Unit construction makes it easier to untank than any other regulator on the market. All you do is disconnect the position indicator and remove a few cover bolts. Since control, tap changer and transformer are a unit assembly, all you do is hoist up on the cover-lifting eyes to inspect the unit. There are no leads to break; there is no oil to handle.

And you'll find a second dividend when this distribution regulator is untanked. It's easy to check operation because you can operate the unit outside the tank merely by energizing the control from an external power source.

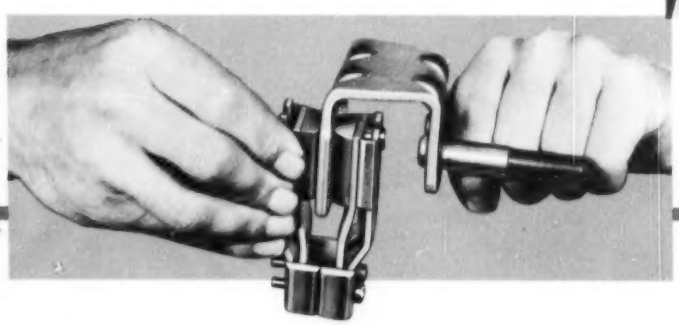
ALLIS-

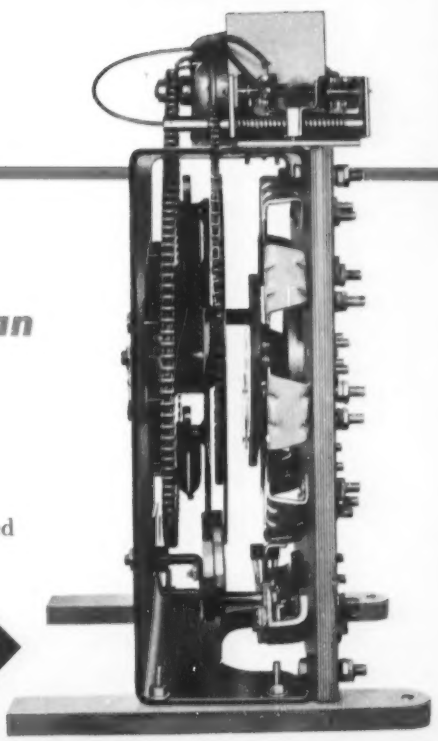
Compare the Dial Switch with Any Other . . . See Why You Get Long Operating Life!



You may find other regulators with dial switches somewhat similar to Allis-Chalmers 5/8% step regulator design. But you won't find any with the solid advantages developed in Allis-Chalmers 20 years of field experience. Look at those big contacts with plenty of arc-resisting material for extra-long operating life. Try the contact pressure yourself; you can't pull these contacts apart. Result: long life with low maintenance.

Allis-Chalmers has proved in laboratory tests that contacts can withstand up to two million operations. Your nearby Allis-Chalmers district office representative can show you contacts that have operated over a million and a quarter times — and they're still good for years of additional service. You get these same advantages in every Allis-Chalmers step-type regulator regardless of rating or number of phases.





Compare the Mechanism . . . See Why It Can Withstand Five Million Test Operations!

Tool designer's skill is obvious when you examine the mechanism of an Allis-Chalmers distribution regulator closely. This mechanism has been proved and improved in field and laboratory for over twenty years. Pictures can't tell the full story. Only operation can show you how its rugged design complements the large contacts and heavy contact pressure.

CHALMERS A-C ALLIS-CHALMERS

COMPARE CONTROLS *see how regulator operation can be simplified*

"Feather-Touch" controls on Allis-Chalmers distribution regulators combine accuracy with ease of installation and operation. For example, key adjustments are pre-set at the factory. Your operating men have a minimum of adjusting during installation. It's easy to make the few settings that are needed with the large, easy-to-read calibration.

Servicing *"Feather-Touch"* controls saves you time and manpower. All you do is pull a single jack plug to disconnect the control. Replacement is fast, simple. Your field men don't need to be highly trained technicians. One man in the shop can handle all problems that might arise because it's easy to bring controls in for checkup. If desired, you can mount the control at the foot of the pole for easier access.

Compare Accuracy

You get ± 1 volt band, Class I accuracy on Allis-Chalmers distribution regulators. Best of all, friction can never upset control accuracy because the floating beam of the voltage regulating relay eliminates the need for a mechanized bearing. You are assured of accuracy over the life of the regulator, producing more revenue and increasing profits on all parts of your system consistently.

Check List Available

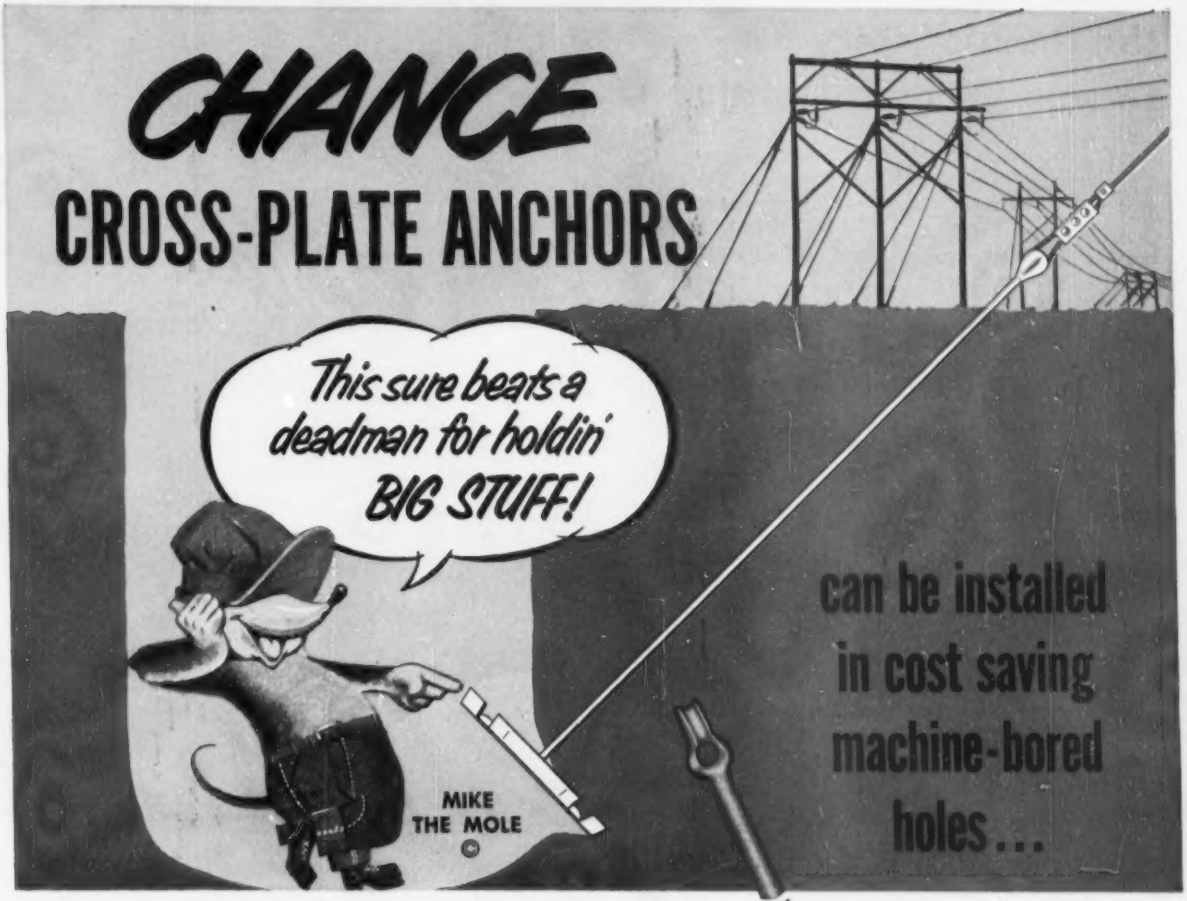
To help you analyze voltage regulators, Allis-Chalmers has published a "regulator check list" pointing out all the regulator features you should know about. To get a copy so you can compare regulators, contact your nearby A-C district office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

MILWAUKEE 1, WISCONSIN

A-C ALLIS-CHALMERS

CHANCE
CROSS-PLATE ANCHORS



Give the Guy a CHANCE

When you're guying "big stuff," like transmission lines, you want an anchor that will hold the load for the life of the line. Not only will a CHANCE Cross-Plate Anchor stay put under really heavy loads, it will enable your company to cut installation costs in half.

In a typical test conducted under laboratory conditions, a CHANCE Cross-Plate Anchor held a load of 70,000 pounds with only a slight distortion, while the maximum load reached before a creosoted log began to split was only 20,000 pounds.

With the CHANCE Cross-Plate Anchor, whether you bore vertically or diagonally—*only one* hole is necessary ... and *all* the boring can be done by machine. Log deadmen require a trench—and digging a trench takes *hours* of manpower. You also save truck and storage space. One man can handle two Cross-Plates, but it takes two to handle a deadman ... so save your company time, labor and dollars. Use CHANCE Cross-Plate Anchors on your "big stuff."

Nut retainer prevents the anchor from riding up the rod as it is placed in the hole.

ABC INDUSTRIES

A·B·CHANCE CO·

CENTRALIA, MISSOURI
SAN FRANCISCO, CALIFORNIA

CHANCE Cross-Plates are available in a range of sizes from 150 to 400 square inches. There is a CHANCE Anchor Distributor near you who can probably fill your order directly from stock.

SPECIFY CHANCE FOR SERVICE!

CA54-15

The "inside" story of *ElectroniK* instruments

Maybe you've never seen what's inside the case of an *ElectroniK* instrument. And even if you have, you might not realize how each component has been painstakingly refined to contribute its share to the overall performance and dependability of the instrument. Three of these components in particular—the converter, "Continuous Balance" amplifier and the balancing motor—are key members of the *ElectroniK* team with which you should get acquainted.

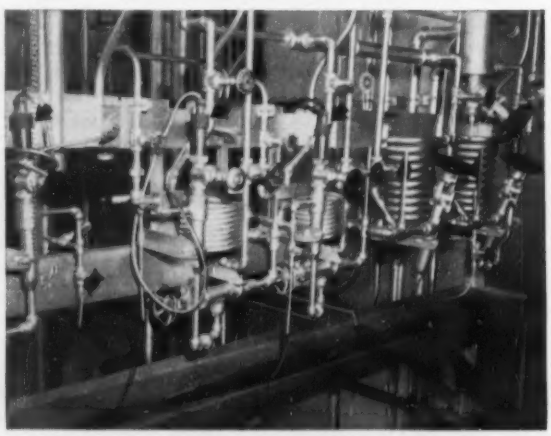
The Converter is what transforms tiny direct-current signals from the thermocouple or other sensing element into an alternating voltage that the amplifier can conveniently handle. In principle, it is somewhat like the vibrator in your automobile radio. But because it deals with such small bits of electrical energy, it has been designed of carefully selected materials which prevent the introduction of misleading signals into the measuring system. It is hermetically sealed against the effects of dust, humidity and atmospheric pressure change, and is shielded against stray electrical and magnetic fields.

The "Continuous Balance Amplifier" boosts the incoming signals by millions of times . . . makes them strong enough to operate the balancing motor. Although it looks like part of a radio chassis, few communications circuits could equal it for quality. It uses standard, easily obtained parts, which are operated far below their normal ratings to insure exceptionally long life. The circuit has great stability against drift and pick-up, and is thoroughly temperature compensated.

The Balancing Motor does the work of moving the pointer, recording pen and any control devices that may be incorporated in the instrument. It packs plenty of power into a small space . . . gives ample torque to give fast, accurate positioning whenever the amplifier calls on it. Totally enclosed, the motor is impervious to dust, dirt and changes in mounting position.

in *Florida* too!

New Ebasco-built station utilizes *ElectroniK* instruments to



Conductivity cells, mounted in sampling lines, are connected to an ***ElectroniK*** *instrument on the central control board, to measure conductivity of condensate, saturated steam and evaporator distillate.*

The new Riviera station of Florida Power & Light Company, near West Palm Beach, features Ebasco's "outdoor" design. Inset shows a bird's eye view of four of the ElectroniK instruments on the central control panel for one of the generating units.

record vital operating data

As modern as tomorrow is the new 131,000-kilowatt Riviera Station of Florida Power & Light Company, which helps to serve the power needs of a fast-growing part of the state. Designed and built by Ebasco Services, Inc., this station features efficient, centralized control . . . in which *ElectroniK* instruments have important responsibilities.

The varied uses which *ElectroniK* instruments fill on this plant's control boards demonstrate the outstanding versatility of these instruments. One of the instruments, for example, helps to safeguard boilers and turbines by recording conductivity of steam and condensate at selected points. Another watches over critical temperatures in bearings, boilers, steam headers, circulating water and other vital spots in the heat cycle. And as an accurate guide to generator loading, other *ElectroniK* instruments provide a continuous record of stator and rotor temperatures.

Brown instruments offer wide coverage of many of the most important points of measurement in modern steam plants, including pressure gages in varied ranges . . . liquid level systems applicable to open and closed vessels . . . pH recording and controlling systems . . . flow meters . . . and a full selection of *ElectroniK* instruments for measurement of frequency, power, reactive power, voltage, current and for telemetering. Both pneumatic and electrical transmission systems are supplied for remote measurement in centralized control designs.

Your nearby Honeywell sales engineer is well qualified to discuss the requirements of your own plant . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Bulletin 80-2, "Supervisory Instruments for Power Generation."

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

More jobs per day

Service-Utility body lockers are triple-sealed against dirt and moisture. Doors are fitted with recessed handles, slam-action catches, and keyed-alike cylindrical locks for full protection. Ladder racks, vise brackets, and pipe supports are also available, providing everything needed for every type of work.

When you put INTERNATIONAL Trucks with Service-Utility bodies into operation in installation or service call work, you get more work done per day.

The Service-Utility body provides all-steel lockers, with compartments of varying sizes, for orderly storage of all the tools, parts, and equipment needed to do a number of different jobs. Thus, there is no costly labor-time wasted in job-to-shop trips for needed or forgetten items.

And INTERNATIONAL Truck quality further lowers your operating costs. Famous INTERNATIONAL engines assure top performance with maximum economy. INTERNATIONAL Tough-Job engineering and all-truck design mean utmost dependability, long life, and lowest maintenance expense.

INTERNATIONAL Trucks with Service-Utility bodies are available in nine models, with 77-inch body lengths for 115-inch wheelbases, 89-inch lengths for 127-inch wheelbases and 96-inch lengths for 134-inch wheelbases. GVW ratings, 4,200 to 8,600 lbs.

Ask your INTERNATIONAL Dealer or Branch for complete details on these time-saving, money-saving workshop trucks. Time payments arranged.

INTERNATIONAL HARVESTER COMPANY • CHICAGO

International Harvester Builds **McCORMICK®** Farm Equipment and **FARMALL®** Tractors . . . Motor Trucks . . . Industrial Power . . . Refrigerators and Freezers

Better roads mean a better America

INTERNATIONAL® TRUCKS

"Standard of the Highway"

Wide Acceptance Shows Need For L-M Heavy Duty Cutouts

L-M's "PHD" (Porcelain Heavy Duty) Fuse Cutouts have met with wide acceptance all over the country. This shows the need that exists for a complete line of cutouts designed and built especially for service on high capacity distribution feeders.

5 kv

50 amperes
8000 amperes
interrupting capacity

100 amperes
14,000 amperes
interrupting capacity

200 amperes
20,000 amperes
interrupting capacity

L-M's "PHD" Cutouts, introduced more than two years ago, comprised the first complete line of heavy duty cutouts with realistic and usable interrupting capacities. Extensive testing was conducted for two years before they were introduced. Special attention was paid to design details, such as cementing, contact alignment, and door and cartridge positioning, which govern successful cutout operation. These cutouts successfully clear both high and low amperage faults—safely, without danger of exploding porcelain—and assure safety for personnel and equipment, and continuity of service.

"PHD" is a Line Material Company Trademark

7.5 kv

50 amperes
4000 amperes
interrupting capacity

100 amperes
8000 amperes
interrupting capacity

Here's Complete "PHD" Line

5 kv Rating	Interrupting Capacity rms amperes	
	2.5 kv*	5 kv**
50 amps.	8,000	5,000
100 amps.	14,000	10,000
200 amps.	20,000	15,000
7.5 kv	**Interrupting Capacity**	
50 amps.	4,000 amperes	
100 amps.	8,000 amperes	

*or line-to-neutral on 4160 or 4330 volts Gr.Y. **or line-to-neutral on 8330 volts Gr.Y.

150

For information ask the L-M Field Engineer for Bulletins, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

LINE MATERIAL

fuse cutouts and fuse links

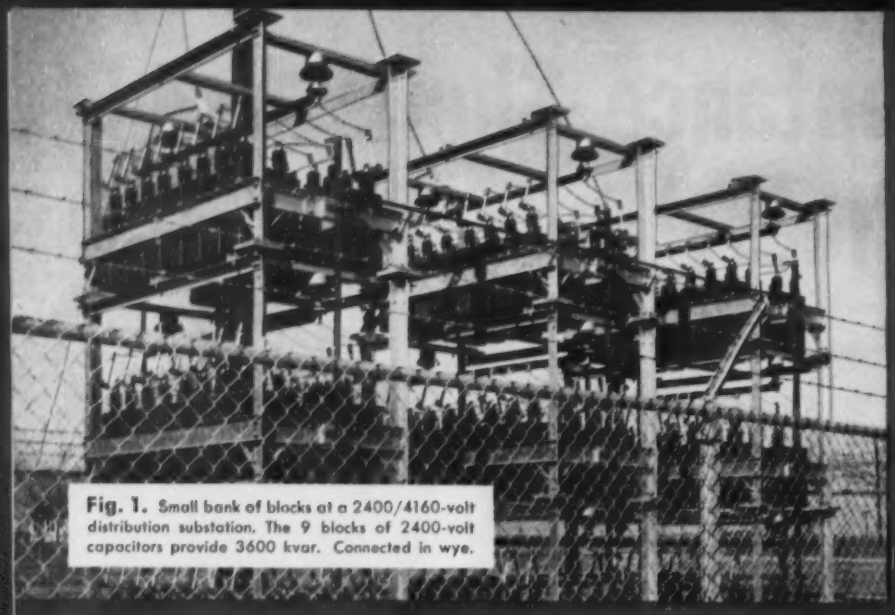


Fig. 1. Small bank of blocks at a 2400/4160-volt distribution substation. The 9 blocks of 2400-volt capacitors provide 3600 kvar. Connected in wye.

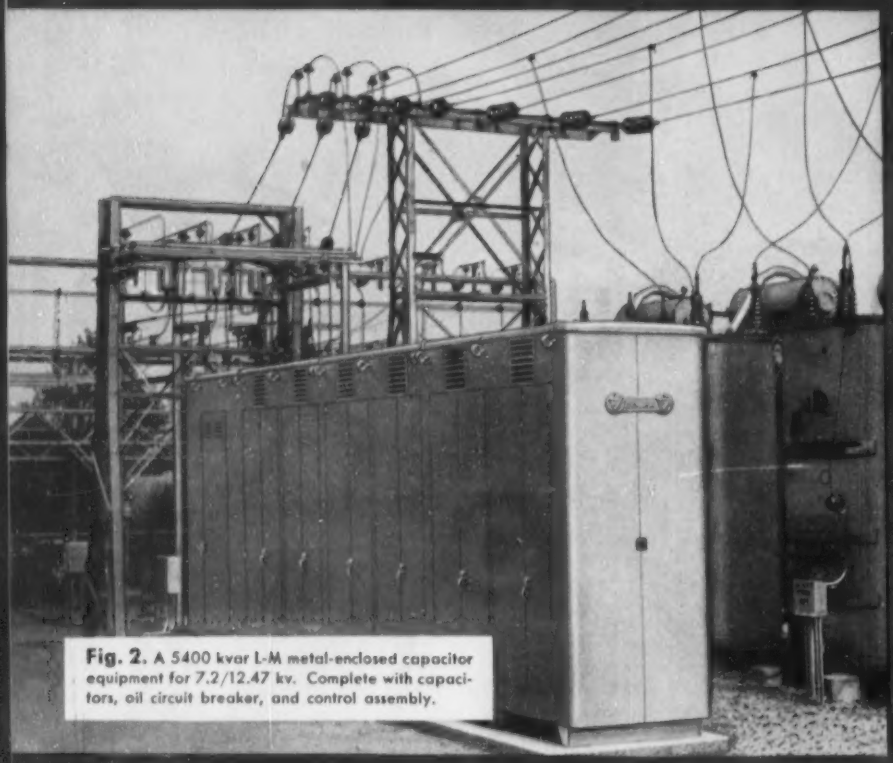


Fig. 2. A 5400 kvar L-M metal-enclosed capacitor equipment for 7.2/12.47 kv. Complete with capacitors, oil circuit breaker, and control assembly.

Fig. 3. A 300 kvar switched capacitor rack serving a suburban area. Note the simple, compact arrangement and accessibility of the entire assembly.

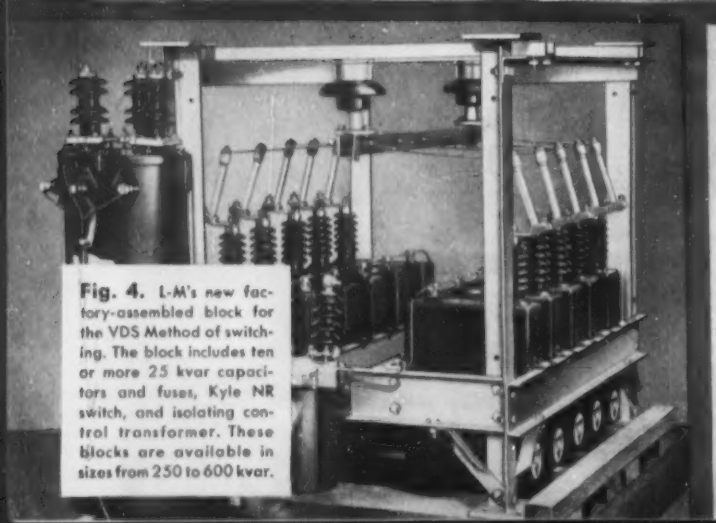
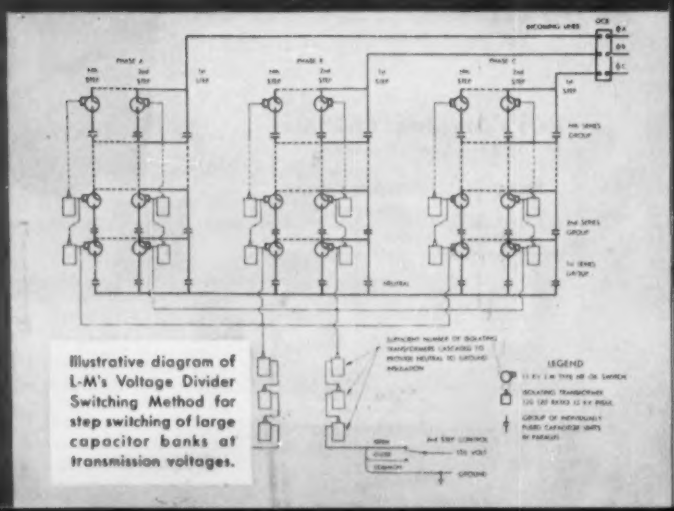


Fig. 4. L-M's new factory-assembled block for the VDS Method of switching. The block includes ten or more 25 kvar capacitors and fuses, Kyle NR switch, and isolating control transformer. These blocks are available in sizes from 250 to 600 kvar.



Illustrative diagram of L-M's Voltage Divider Switching Method for step switching of large capacitor banks at transmission voltages.

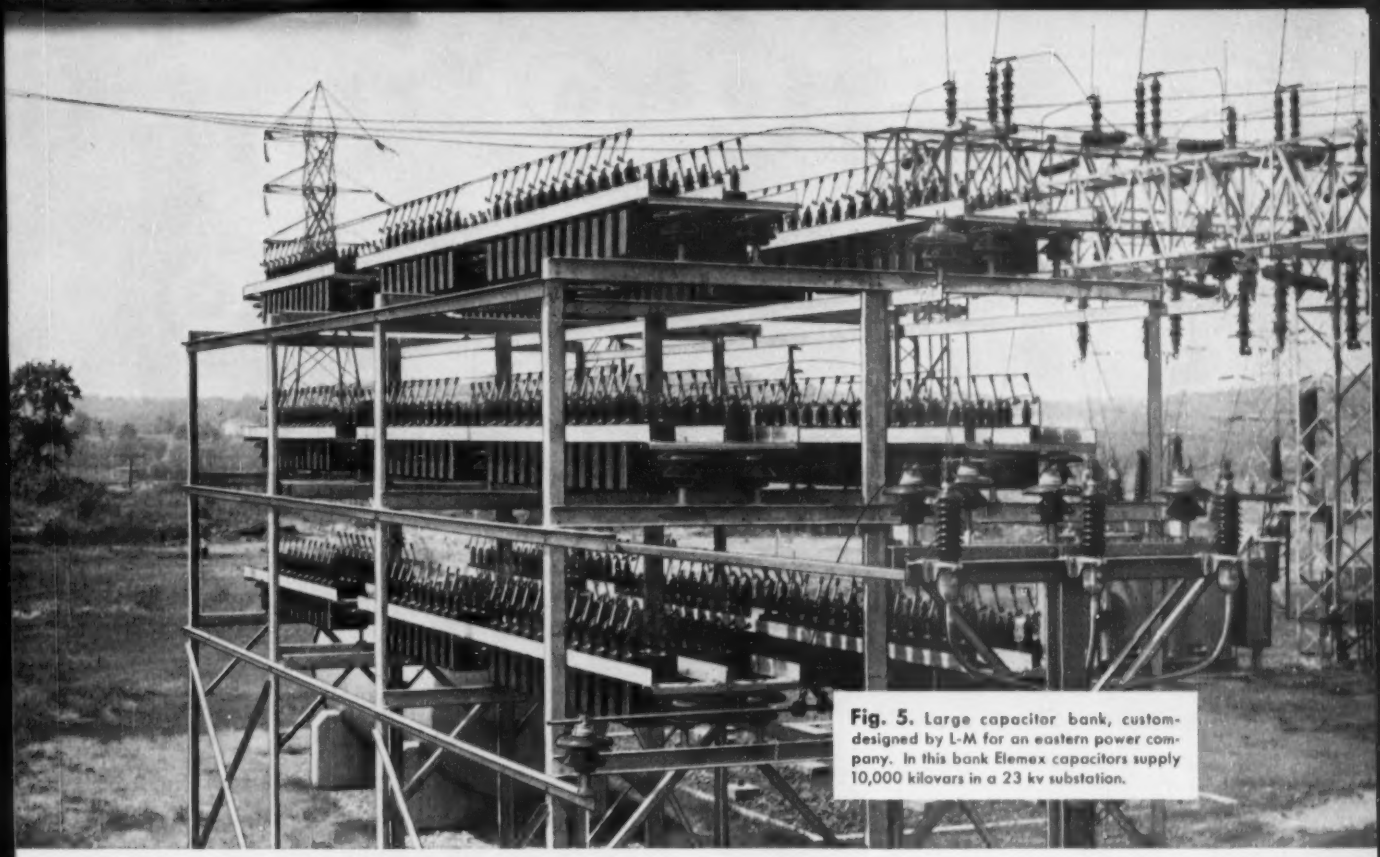


Fig. 5. Large capacitor bank, custom-designed by L-M for an eastern power company. In this bank Elemex capacitors supply 10,000 kilovars in a 23 kv substation.

L-M Offers Completely Engineered Capacitor Bank Installations

L-M's service includes a full line of equipment and experienced custom designing of any size of bank for transmission or distribution lines.

By **N. K. DELANEY**
Manager of Capacitor Sales
Line Material Company

The application of capacitors to distribution and transmission lines requires careful consideration of both electrical and economic factors. A large amount of information on equipment, protective schemes and cost must be available to the utility engineer for an intelligent decision.

Line Material Company is prepared not only to supply you with such information, but also to cooperate with utility engineers in working out the most satisfactory capacitor-application designs. This includes the best possible protective and step-switching schemes for any size and type of bank for operation at transmission or distribution voltages.

L-M's complete line of capacitor equipments includes pole-mounted racks factory-assembled blocks, metal-enclosed equipments, and custom-designed field-assembled banks.

Another and exclusive service to the industry is the L-M Voltage Divider Switching Method (patent applied for). This is an automatic switching scheme for large multi-step capacitor banks at transmission voltages. It involves substituting a number of low-cost 15 kv oil switches for the large circuit breakers on all but the first step on multi-step banks up to 230 kv. The VDS Method saves about 40% of the cost of breakers alone. A special block assembly has been designed to simplify installation of the VDS Method.

Ask Us For Complete Information

We would appreciate an opportunity to tell you about our products, and about our Capacitor Bank Engineering Service. Ask the L-M Field Engineer to discuss it with you; or write Capacitor Sales, Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

L-M Capacitor Equipments

Factory-assembled blocks in complete range of NEMA-standard sizes and ratings. Blocks save time and money in assembling large banks. (Fig. 1)

Metal-enclosed capacitor equipments in all NEMA-standard distribution voltage sizes and ratings. (Fig. 2)

Factory-assembled racks for pole-mounted banks. Sizes with 15 kv spacing up to 300 kvar switched and 375 kvar unswitched assemblies with 25 kvar units. (Fig. 3)

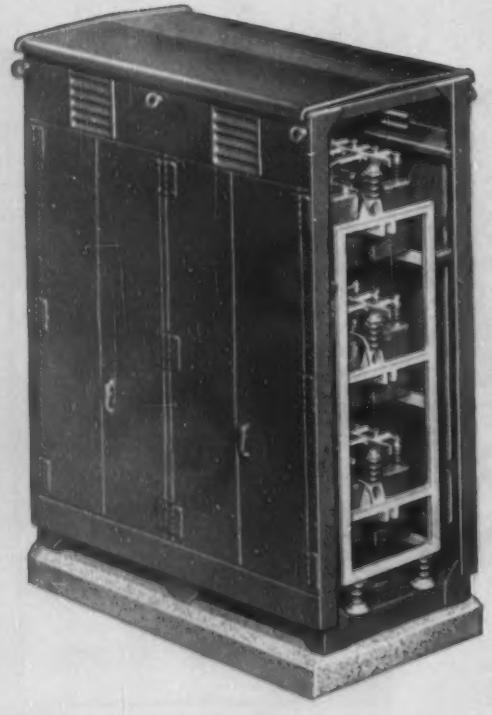
VDS Method factory-assembled block for large multi-step capacitor banks, an L-M-exclusive method that reduces costs of switching equipment. (Fig. 4)

Custom-designed field-assembled banks with recommendations for the protective and switching schemes. (Fig. 5)

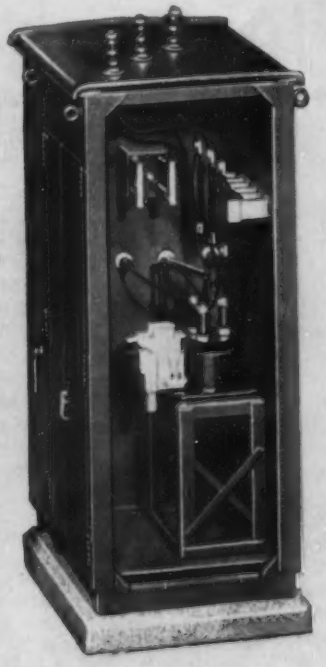
LINE MATERIAL

Elemex® Capacitors

Scale models of L-M Metal-Enclosed Capacitor Equipments. At extreme right is control compartment; next, the oil circuit breaker compartment; center, an 1800 kvar compartment with doors opened to show Elemex individually fused capacitors in racks.

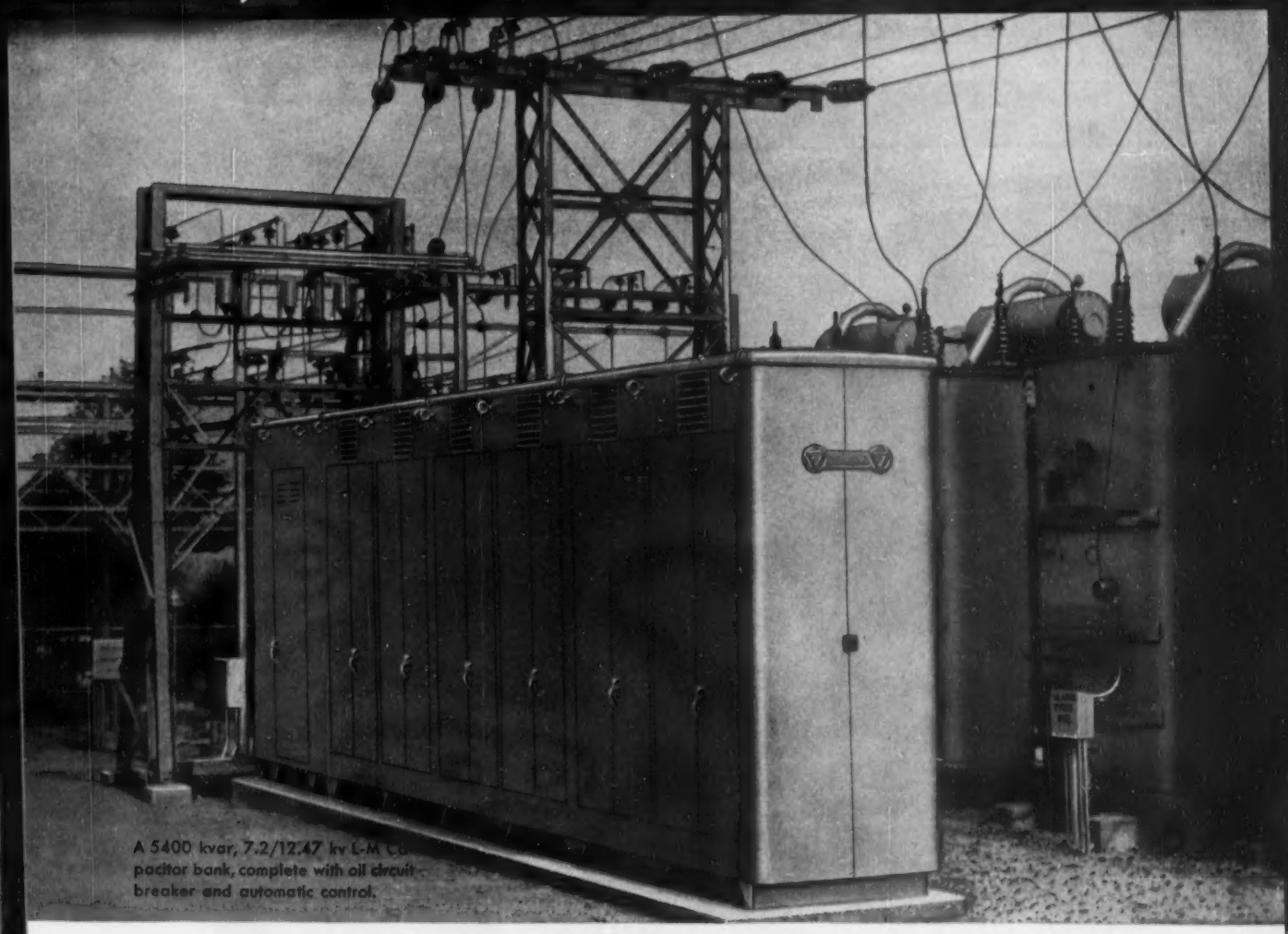


Scale model of an 1800 kvar capacitor compartment, showing how capacitor units and fuses are mounted on insulated inner rack behind interlocked doors.



Typical oil circuit breaker compartment includes breaker, current and potential transformers, and accessories.

Typical control panel with overcurrent relays, ammeters, recording voltmeter, voltage control, and other necessary relays and control switches.



A 5400 kvar, 7.2/12.47 kv L-M Ca... pacitor bank, complete with oil circuit breaker and automatic control.

L-M's Metal-Enclosed Capacitor Equipments Provide Wide Choice of Sizes and Arrangements

by **N. K. DELANEY**
Manager of Capacitor Sales
Line Material Company

L-M's Metal-Enclosed Capacitor Equipments provide a self-contained three-phase bank with or without switching equipment and complete controls. The assembly makes a neat-appearing installation; is extremely compact; and provides a high degree of safety, because no live parts are accessible except through doors which are interlocked with the short-circuiting and grounding switch.

L-M's Metal-Enclosed Capacitor Equipments provide wide flexibility. All control equipment is in one compartment. A second compartment contains the circuit breaker, current and potential transformers, and short-circuiting and grounding switch.

Capacitor compartments contain racks of Elemex capacitors. Sizes range from 600 to 1800 kvar, and voltages from 2400 to 13,800. These compartments are provided with thermostatically controlled cooling fans, and doors interlocked with the grounding switch. Equipments are exceptionally rigid, heavy steel, completely finished for long protection against weather. All capacitors have individual bus-mounted flameless fuses with indicating feature. A variety of convenient accessories is available. Connections may be underground through potheads, or to bushings at top of breaker or power entrance compartment.

Get The Details

Ask the L-M Field Engineer for complete information about L-M Metal-Enclosed Capacitor Equipments and about L-M's Complete Capacitor Application Engineering Service. Or write Line Material Co., Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

Sizes and Ratings Available

L-M Metal-Enclosed Capacitor Equipments are available in the following NEMA-standard ratings:

2400/4160 volts: 600, 900, 1200, 1800, 2700, and 3600 kvar.

4800, 7200, 12,470, and 13,800 volts: 900, 1800, 2700, 3600, 4500, and 5400 kvar.

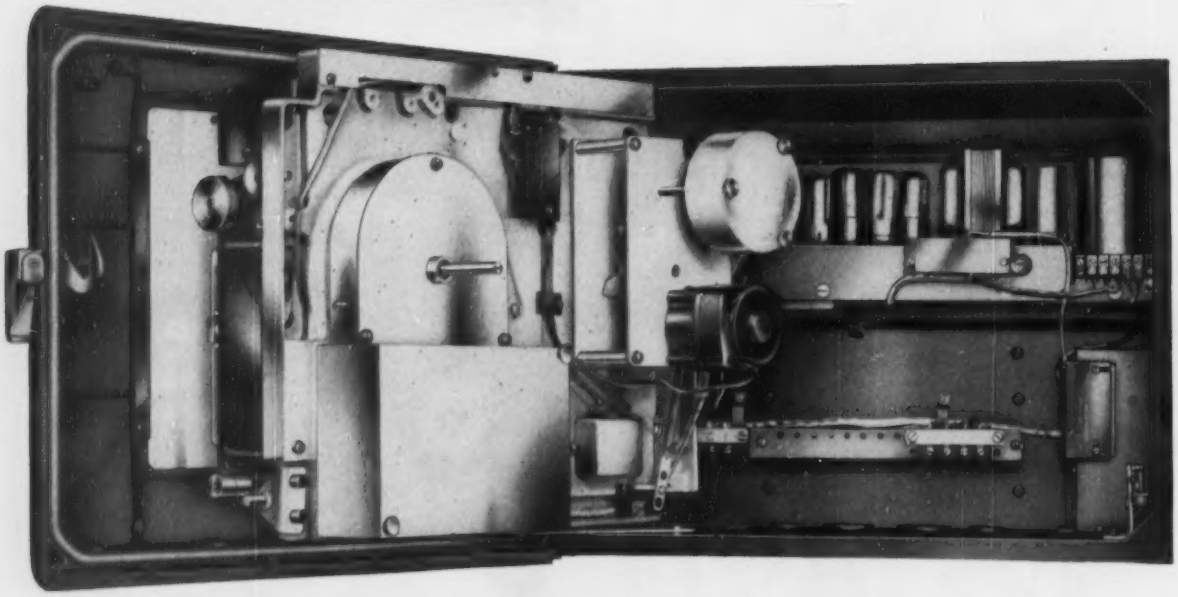
In 5 kv class equipments the capacitor compartments are in 600, 900, 1200, and 1800 kvar sizes.

In 8.7 and 15 kv class equipments standard compartment sizes are 900 and 1800 kvar.

186

LINE MATERIAL *Elemex Capacitors*

WHAT'S NEW AT BRISTOL...



CONTINUOUS STANDARDIZATION UNIT of the electronic Dynamaster eliminates need for dry cells and standardizing mechanism. Result: no interruptions in operation for standardization; no batteries to replace.

Measures any variable that can be translated into an electrical quantity

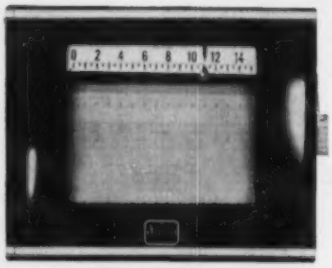
Bristol's Dynamaster Potentiometers have earned a world-wide reputation for accuracy and dependability in recording, indicating, and controlling temperature, pH, speed, voltage, power, current, resistance, smoke density, strain – the list could go on and on.

Behind this reputation is 65 years of instrument-making research and experience – all aimed at making Bristol instruments as precise and trouble-free as humanly possible.

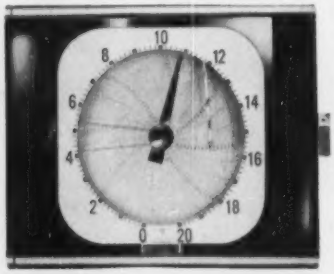
One result of this research is our new No-Batt continuous standardization system, which is used in Dynamaster Potentiometers and Pyrometers. With continuous standardization eliminating the need for dry cells, the potentiometer is free to continuously measure, record and control. No time out is required for periodic standardization.

And all Dynamasters are "human-engineered", making them easier to read and clearly visible at greater distances. Simplified construction, fast operation, fewer moving parts are all achieved through Bristol's "human engineering".

Get the whole story on these rugged, precision instruments. Write today for free 36-page bulletin P1245. The Bristol Company, 116 Bristol Road, Waterbury 20, Conn. 4.26



BRISTOL ELECTRONIC DYNAMASTERS are made in round- and strip-chart, single- and multiple-record recorders, air-operated and electric controllers (all types of control actions). Two-pen and Program Control.



BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

You Get EXTRA Protection with

DEEP... DEEP GROUNDING

Insure protection of your expensive equipment this low-cost, efficient way

Drive down to moist soil that gives lower earth to rod resistance. Actual experience shows a few dollars invested in deep grounding has saved thousands of dollars in overhead burn-outs.

- **BLACKBURN** Sectional Rods have uniform coating of highly conductive corrosive-resistant copper, molecularly bonded to rigid steel core.
- Driving studs and coupling interchangeable with all standard sectional ground rods.
- Available through Electrical Distributors.

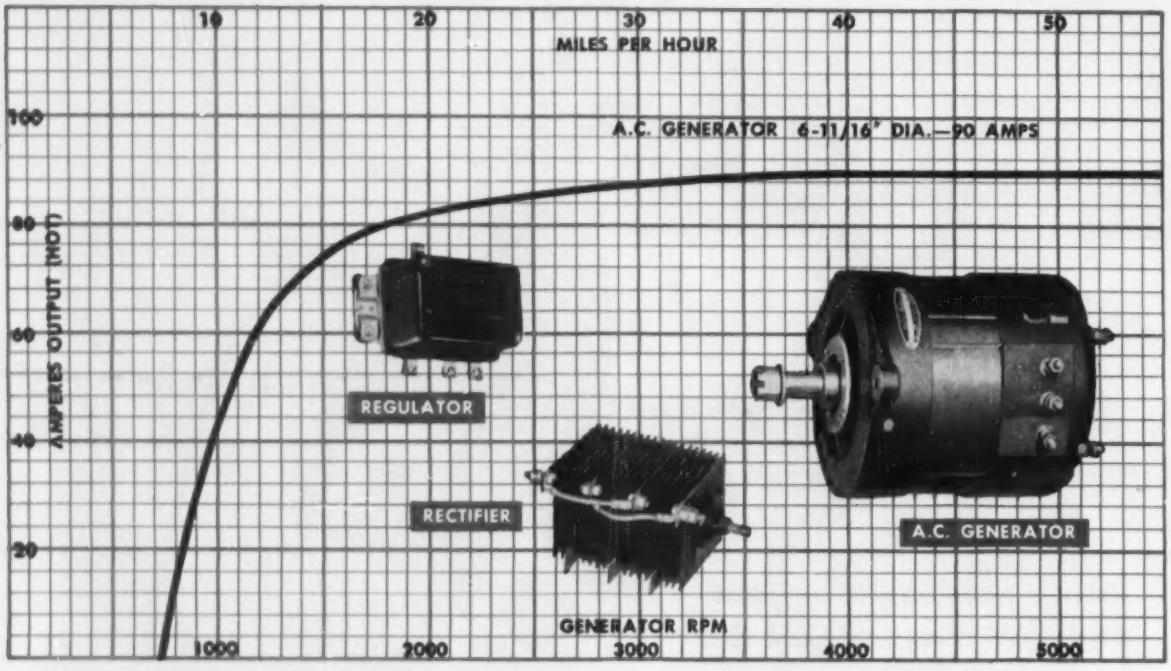
BLACKBURN Sectional COPPER BONDED GROUND RODS

JASPER BLACKBURN CORPORATION
35 Madison Street • St. Louis 6, Missouri
Phone MAin 1-2821

Distributed on the West Coast by KORTICK MFG. CO.

Power Packed and

HERE'S THE A.C. ANSWER TO EXTRA-HEAVY ELECTRICAL DEMANDS



DELCO-REMY

A. C. Generator, Regulator and Rectifier

Here's the answer for "problem" vehicles—Delco-Remy's new long-lived A.C.-D.C. charging system! It's specifically designed to meet the *extra*-heavy electrical demands of public utility trucks and other vehicles equipped with two-way radio, floodlights or any extra electrical units . . . ample current reserve picks up discharged battery quickly in operation. Delco-Remy A.C. generators are suitable for use at all engine speeds.

With output ranging from 30-40 amperes at curb idle and up to 90 amperes at higher engine speeds, the new Delco-Remy A.C.-D.C. charging system meets all electrical needs under the toughest operating conditions. Included in the new system is the A.C. generator, a matching regulator, and a rugged, dependable dry-plate rectifier which converts generator A.C. output to direct current.

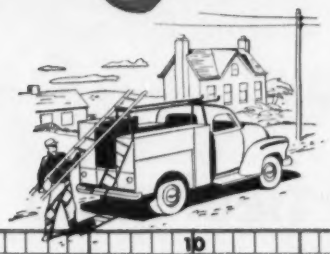
Application packages complete with installation instruction sheets for popular makes of cars and trucks are now available. The conversion job is simple. For further details and application data, see your nearest United Motors distributor.

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

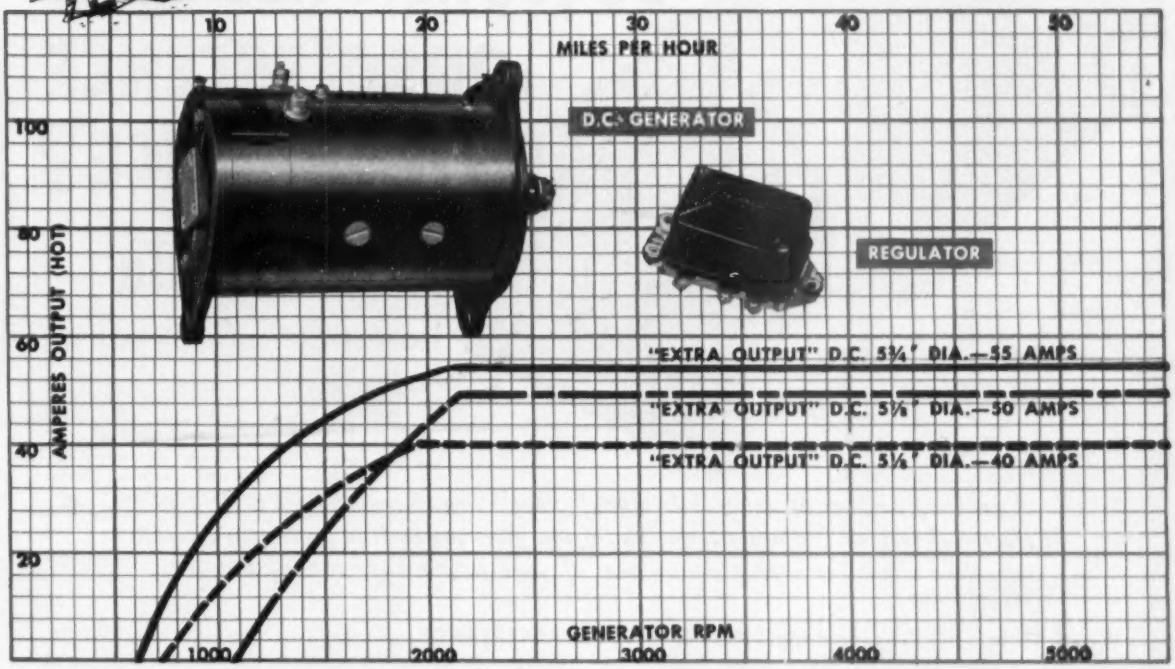
DISTRIBUTED BY WHOLESALERS EVERYWHERE

WHEREVER WHEELS TURN OR PROPELLERS SPIN

Right for the Job



HERE'S THE D.C. ANSWER TO HEAVY ELECTRICAL DEMANDS



DELCO-REMY

Extra-Output D. C. Generators and Matching Regulators

Delco-Remy extra-output D.C. generators are an economical answer to the electrical needs of public utility pickup or panel trucks as well as other vehicles with additional lights, two-way radios, or other special electrical equipment in medium to heavy-duty service. Delco-Remy extra-output D.C. generators are low in cost, simple to install, economical to maintain.

DELCO-REMY 40-AMP GENERATOR has low cut-in, about 7 mph, charges from 11 to 17 amperes at curb idle . . . full output about 18 mph —for vehicles customarily used in heavy traffic.

DELCO-REMY 50-AMP GENERATOR has slightly higher cut-in, about 11 mph . . . full output about 21 mph—for vehicles customarily operated at higher speeds, with minimum slow driving.

DELCO-REMY 55-AMP GENERATOR has very low cut-in, about 6 mph; charges at curb idle from 20 to 30 amperes . . . attains full output at 20 to 25 mph—for vehicles customarily operated at low speeds with added electrical loads, such as city taxicabs and police cars.

For further details and application data, see your nearest United Motors distributor.

Delco-Remy

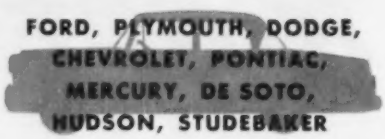
DIVISION, GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

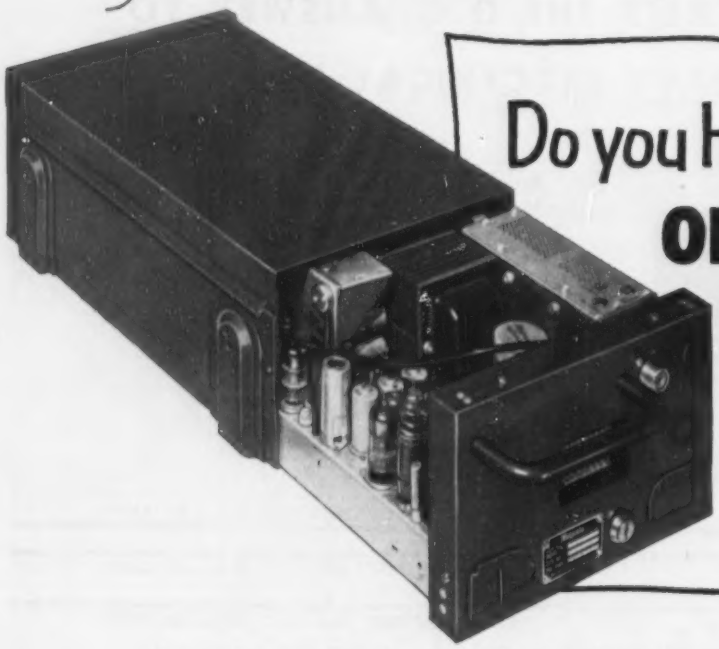
WHEREVER WHEELS TURN OR PROPELLERS SPIN

12 VOLT ELECTRICAL SYSTEM

These already have it!

How many will have it by 1955-1956?





Do you have fleet radio OBSOLESCENCE INSURANCE?

Motorola had it *built-in* a year ago

A growing number of automobile manufacturers are changing from 6 to 12 volt electrical systems. Motorola 2-way radio now gives you built-in protection against expensive obsolescence should any part of your fleet be affected by this trend.

WHAT IT IS—It's truly universal 6/12V equipment—2-way radio that can be interchanged in mixed 6 and 12-volt fleets without modification of power supplies, jumpers, plugs, connectors, cables or switches. When re-installing in a 12-volt car, no cable replacement is required. It is so fool proof that you can safely make changeovers in the dark without worry of burning out tubes or damaging a power supply.

FEATURES—The *all-vibrator* power supply attains over 70% power conversion efficiency with a resultant power drain reduction of up to 40%—for more power per unit size per ampere drain than any other sets on the market. This, plus the superior performance of Motorola's famous Sensicon with guaranteed permanent selectivity and seven other exclusive features.

ACCEPTANCE—Again anticipating the trends, Motorola offers freedom from obsolescence, and superior performance at lower cost. You can easily see and hear the difference—greater signal strength, more audio power, longer battery and generator life, lower maintenance costs. You get all this in Motorola's truly universal 6/12-volt mobile units—available in the following classes:

- 25-54 mc., 25-30 and 50-60 watts R.F. output
- 144-174 mc., 10 and 25 watts R.F. output
- 450-470 mc., 18-20 watt R.F. output

Here is a partial list of Motorola 2-way Radio customers who had 6/12 volt interchangeable mobile units—a year ahead of the field

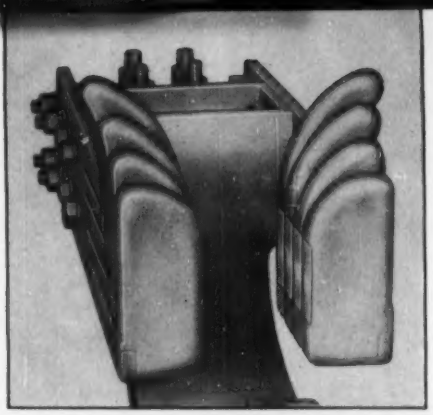
Michigan State Police
Ohio State Police
Shell Oil Co.
Community Public Service Co.
County of Orange, Calif.
El Paso National Gas Co.
Boston Edison Co.
Florida State Police
Iowa State Police
State of South Carolina

national **Motorola** RADIO COMMUNICATIONS service

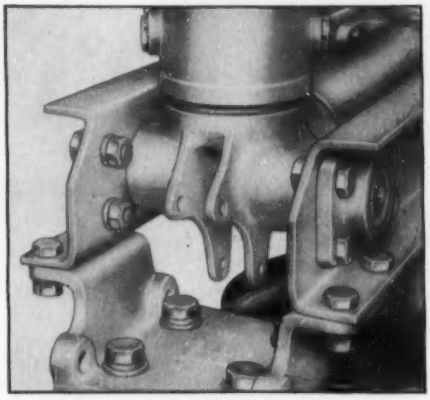
Motorola Communications & Electronics, Inc.

A SUBSIDIARY OF MOTOROLA, INC.

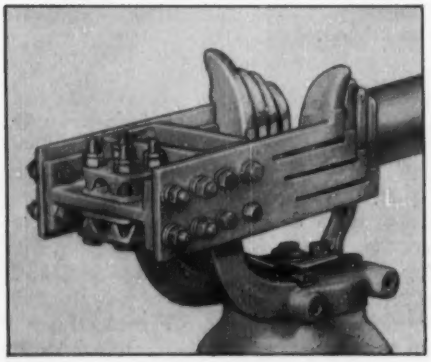
4501 W. Augusta, Chicago 51, Ill. • Rogers Majestic Electronics, Ltd., Toronto, Canada



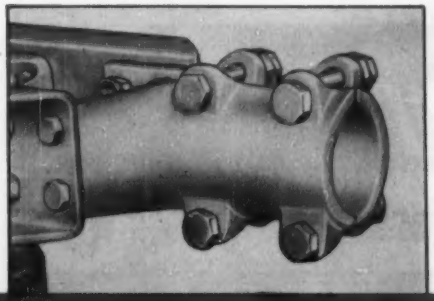
1. Silver to copper, non-galling Hi-Pressure, multi-contact — straight thru jaw designed for Hi-Momentary capacity.



2. Sealed Pressure Hinge Contact withstands currents in excess of rated momentary ratings — operates with sled-runner ease. Blade operates on similar protected internal contact.



3. Above, and below — Terminals straight in line with jaw and current carrying frame — designed for either flat bar or
4. round conductor.



Type TTR49

HI-CURRENT SWITCHES

Designed for the thermal and electro magnetic problems associated with modern high short-circuit currents

with these

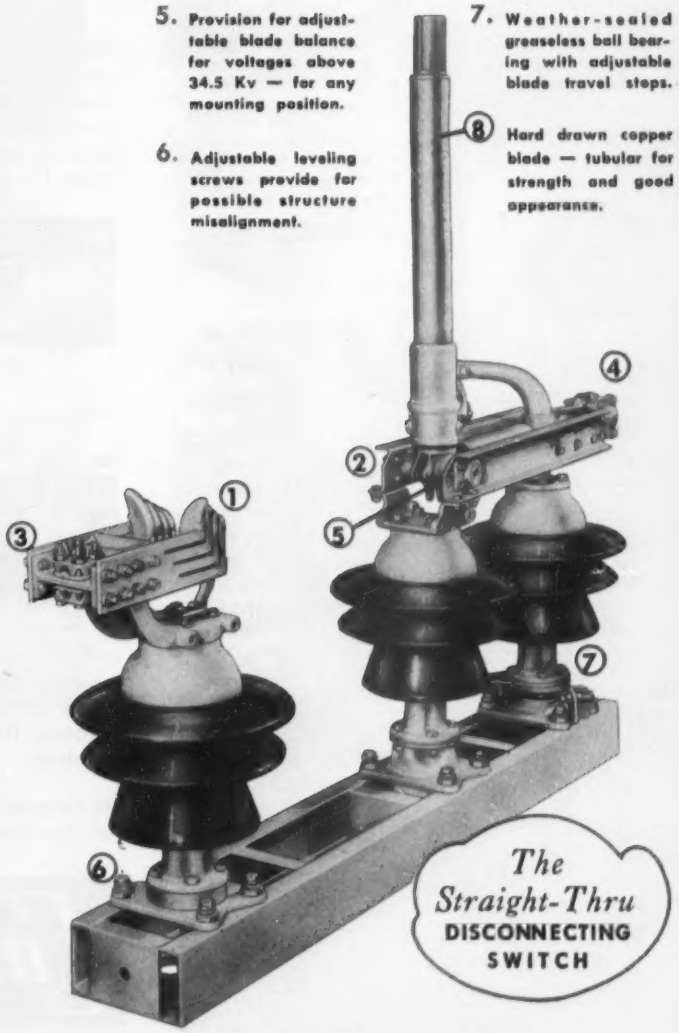
NEW ADVANCED R&IE FEATURES

5. Provision for adjustable blade balance for voltages above 34.5 Kv — for any mounting position.

6. Adjustable leveling screws provide for possible structure misalignment.

7. Weather-sealed greaseless ball bearing with adjustable blade travel stops.

8. Hard drawn copper blade — tubular for strength and good appearance.



The Straight-Thru DISCONNECTING SWITCH

R&IE SWITCHING EQUIPMENT

DIVISION OF I-T-E CIRCUIT BREAKER CO.

GREENSBURG, PA.

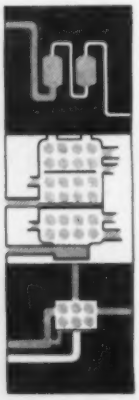
STRUCTURES—round or flat conductor • TESTING DEVICES • KITS OF VARIOUS SYSTEMS • ISOLATED PHASE BUS STRUCTURES • INTERRUPTER SWITCHES

INDOOR BUS SUPPORTS and BUS FABRICATION • OUTDOOR BUS SUPPORTS and AIR SWITCHES • SUBSTATION

Waterfall . . . or Washout?

It all depends on your viewpoint. As scenery, this torrent rates plenty of attention . . . but it's strictly a troublemaker for your power plant equipment.

That's why it will pay you to investigate the cost reduction possibilities of Carpenter Stainless Tubing and Pipe. At a growing list of steam-generating stations, they are *proving* their ability to provide maximum corrosion-resistance, time-saving and trouble-free fabrication, lightweight strength and reduced maintenance costs. For example . . .



When the pH of your make-up water has an acid tendency . . . Carpenter Stainless Tubing defeats the carbon dioxide corrosion which results from the carbonates found in raw make-up water in many areas.

Carpenter Stainless Tubing eliminates carbon dioxide corrosion in evaporators . . . provides the smooth, easily-cleaned surface that saves maintenance time for you.

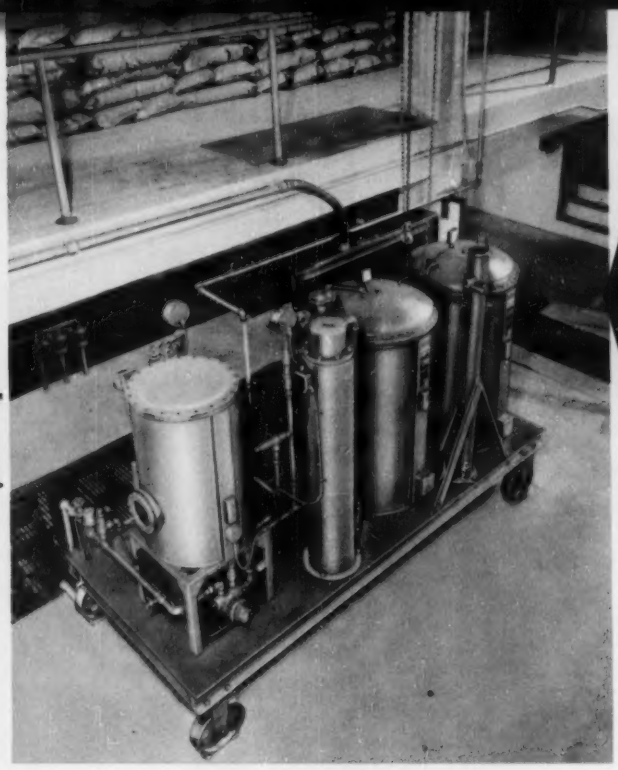
Carbon dioxide corrosion in a vent condenser can be a source of continued annoyance and expense. That's why it's smart to switch to Carpenter Stainless, to avoid frequent tube failures.

If you're interested in trouble-free operation—and reduced maintenance costs—for your plant, why not see what Carpenter can do for *you?* Just pick up the phone and talk things over with your Carpenter representative. He has the answers to *your* corrosion-control problems.

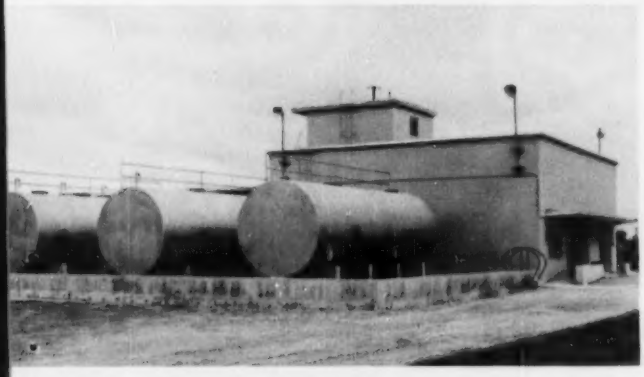
The Carpenter Steel Company, Alloy Tube Division, Union, N.J.
Export Dept.: The Carpenter Steel Co., Port Washington, N.Y.—"CARSTEELCO"

Carpenter

Stainless Tubing & Pipe



Houdaille Purivac purifies insulating oil at central station of Public Service Co. of Indiana. Mobile unit equally efficient in the field without taking transformers out of service. Special "Cranite" filtering medium, stored above unit, allows quick, easy change of refills.



Houdaille *Purivac*

RESTORES USED TRANSFORMER OIL TO *NEW* OIL SPECIFICATIONS!

at

PUBLIC SERVICE COMPANY of INDIANA

Plainfield, Indiana

Large Electric Utility Gets Low-Cost Purification of Insulating Oils . . . *Automatically* . . . *Continuously*

Since August, 1953, the Public Service Company of Indiana has employed a Houdaille PURIVAC to purify insulating oils used in transformers, circuit breakers, regulators and other oil-filled equipment. Compact unit removes virtually all trace of acidity; performs complete purification, dehydration and degasification in one automatic operation.

Purivac Equipment *Pays for Itself* Through Oil Savings Alone!

Purivac program provides a steady supply of clean, safe insulating oil; is estimated to purify 100,000 gallons or more the first year. Savings in oil alone, realized within one year, will more than pay for the unit—makes it a profitable as well as practical investment!

PURIVAC Program *Completely Restores* Color, Neutralization Number and Dielectric Strength of Oil

Tests conducted by Public Service Company of Indiana on PURIVAC purified oil show:

Neutralization Number of	Interfacial Tension of	Dielectric Strength of
less than .1	above 35	above 30

Safe-use life of the oil has been greatly extended, providing substantial savings in oil replacement. Regular oil maintenance program prevents power failures and equipment damage due to contaminated oil.

Method of Purification Practical and Economical!

Contaminated oil from transformers and other equipment undergoing service in the Electric Building (not shown) is pumped into a storage compartment of the processing tank, shown at extreme left of opposite picture. Oil circulates through a 500 GPM Purivac, located within the central station (shown upper left) and out into the other compartments of the processing tank. Oil is re-circulated through the Purivac (2 or 3 times, depending on acidity) until desired properties of the oil are restored. Purified oil is then pumped into the middle tank for distribution to delivery trucks or routing back to Electric Building. Tank at far right is reserved for new oil, also equipped with direct lines to the Electric Building.

new

RENTAL PLAN ON PURIVACS NOW AVAILABLE!

Write for bulletin giving complete information and specifications on the Purivac.

Here are some of the many other companies using PURIVAC oil purification to reduce power failures and equipment damage caused by deteriorated oil:

Omaha Public Service District
Portland General Electric
Cincinnati Gas & Electric Co.
Indianapolis Power & Light
Industrial Rayon
Kansas Gas & Electric
Memphis Power & Light
Minnkota Electric Service Co.
Westinghouse Electric International
City of Los Angeles
National Lead Company
Central Maine Power Company
Northern States Power
Iowa Public Service Co.
Pennsylvania Power & Light
Quebec Hydro-Electric Comm.
Philadelphia Electric Co.
Aro, Inc.
Doble Engineering Co.
Eastern Shore Public Service

see other side

Houdaille DRI-PURE Stands Guard against Water Contamination in AUXILIARY TURBINE DRIVES...

at Consolidated Edison's Sherman Creek Generating Station · NEW YORK CITY, NEW YORK

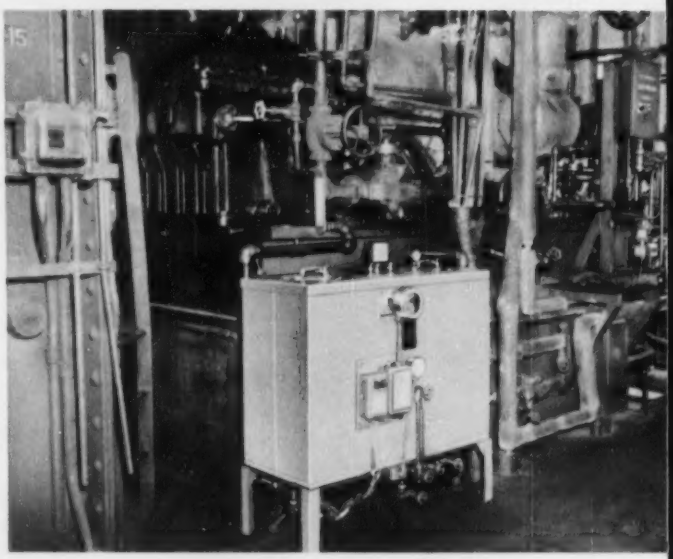
problem—Consolidated Edison's Sherman Creek Generating Station has two 1,000,000 lb./hour high pressure boilers supplying two 50 MW topping turbines which exhaust to eight low pressure turbines. Each boiler has two induced and two forced draft fans—each pair driven by one auxiliary turbine and reduction gear set which has a common lubricating and governing oil system with approximately 100 gallons capacity. Turbine or gear failure would result in loss of 100 MW of load.

HOUDAILLE DRI-PURE *Automatically* Removes Water from Lubricating and Governing Oil; Keeps it Clean, Safe to Use Indefinitely!

Four ½ GPM Houdaille Dri-Pures were installed to service the two boilers. Oil systems for each of the four turbine-reduction gear fan drive sets are kept clean, free from moisture and other contamination by individual Dri-Pures.

HOUDAILLE DRI-PURE Reduces Equipment Failure; Provides Maximum Operating Efficiency!

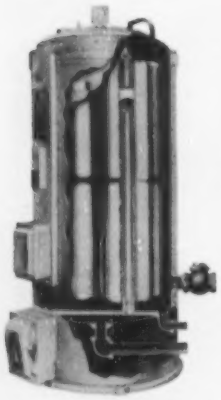
Dri-Pure's continuous, fully automatic water-separating, oil filtering characteristics eliminate unnecessary downtime and repairs . . . keep fan sets operating efficiently, economically without interruption. Compact units occupy minimum floor space; will actually pay for themselves through savings in oil consumption alone!



Houdaille Dri-Pure connected to induced draft fan set of one of Consolidated Edison's high pressure steam boilers.

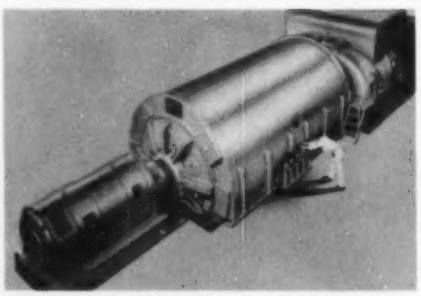
WRITE TODAY FOR COMPLETE INFORMATION ON THE HOUDAILLE DRI-PURE. Equally efficient on oils used in vacuum pumps, turbines, hydraulic systems, etc. Equipment bulletin sent on request.

Honan-Crane Oil Purifiers Give You 2-WAY PROTECTION for TURBINE OILS



Honan-Crane Oil Purifiers are engineered so that either Cranite (adsorbent type filtering material) or Palconia (cellulose fiber) can be used interchangeably as the filtering medium. This flexibility of design makes it possible to meet any type of contamination problem that may arise with turbine oil.

Many leading operators use Honan-Crane Oil Purifiers on a "changeover" purification schedule to insure safe and trouble-free operation. Palconia is recommended for continuous removal of solid particles while Cranite is used for the occasional emergency where steam emulsion and neutralization numbers rise above safe limits.



The Ohio Public Service Company has used Honan-Crane Oil Purification equipment continuously for ten years. Honan-Crane Purifiers are installed in five of its big Ohio generating stations which produce a total of 470,000 kilowatts.

write today for complete information about Honan-Crane Purifiers for Turbine Oil

HONAN-CRANE CORPORATION, Lebanon, Indiana
Subsidiary of HOUDAILLE-HERSHEY CORPORATION

Prepared for trouble?

You don't have to be armed to the teeth to avoid communications trouble. Not when your communications are supplied by the Bell System.

A planned program of preventive maintenance is an important part of Bell System service. Its purpose is to prevent interruptions in service.

In the laboratory, technicians are continually developing new and more efficient equipment. In the field, Long Lines plant and commercial experts frequently visit critical points of your communications system to observe conditions and to improve operations.

Alternate routings are an integral part of planning by telephone engineers to protect your service.

The entire program is backed by the Bell System's 78 years of communications experience.

We supply the power industry with reliable private-line telephone, mobile telephone and teletypewriter service, and channels for remote metering and supervisory control.

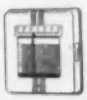
. . .

Your Bell Telephone Company will be glad to study your communications problems and needs.

PRIVATE-LINE TELEPHONE

TELETYPEWRITER

MOBILE TELEPHONE



METERING CHANNELS

BELL TELEPHONE SYSTEM

Public Utility Enemy No. 1 now attacked by Kennecott!

Inadequate residential wiring. The kind of wiring you'll find in more than 80% of the homes in your area. The kind of wiring that curbs appliance sales, bottlenecks current consumption. That's your biggest business enemy of today. You know this. So does Kennecott!

Advertisement No. 2 of Kennecott's national advertising drive against inadequate wiring appears on the right. Its message will reach over 15,130,000 readers of the Saturday Evening Post and This Week magazines. It's part of a complete campaign of advertisements which will hammer away at inadequate wiring.

The story this campaign tells is as simple as it is effective. It shows home owners and home planners how to recognize the symptoms of wiring weakness in their homes and what to do about them. It's an *educational* campaign *bound to benefit everyone* in the electrical industry!

Tie In With Us!

Let's work together for adequate wiring! Key your own local promotions to this Kennecott campaign. Inquire about reprints and blow-ups of advertisements for your mailings, displays. Write Kennecott! Address your letter to Carl Lenz, President, Kennecott Sales Corporation, 161 East 42nd Street, New York 17, N. Y.

They're showing old-fashioned "flickers" in so many homes these days!

Bright! Dim! Bright! Dim! Annoying, isn't it? Yet, you'll find lights flickering like this in 80% of America's homes. Why? Because the *wiring* in most homes today is just plain *outdated*. Wires are too small, circuits too few, to feed enough electricity to the scores of new appliances people have bought in recent years!

Take your own home. If it's 10 or more years old, you can be *sure* its original wiring cannot carry all the current needed. *Even if your house is brand-new, its wiring may become overloaded if you add only one new appliance!* For instance, a room air conditioner or a laundry dryer.

But, whether your house is old or new, remember this – if its wiring is weak, you're putting up with *more than annoyance*. You're *wasting money* in lost current. You're *risking fire* from overloaded, overheated wires!

So, if your home has the "flickers," don't laugh it off. Talk it over with your local electrician!

Look To Your Electricity!

✓ **If you own a house,** see your electrician. He will gladly make a study of your wiring system, tell you what work if any may be needed, and its cost.

✓ **If you plan to buy a house,** don't forget to check up on the age and capacity of its wiring. Better still, have an electrician inspect it for you!

✓ **If you are going to build,** be sure to plan your wiring for the *future* as well as the present. Remember that on the average, your electrical needs increase 10% every year!

Kennecott Copper Corporation,
161 E. 42nd St., New York 17, N. Y.

Published for your information by

Kennecott
COPPER CORPORATION

Fabricating Subsidiaries: CHASE BRASS & COPPER CO. KENNECOTT WIRE & CABLE CO.

This advertisement will appear, with a circulation of 15,130,000, in the Saturday Evening Post and in This Week. Other Kennecott advertisements will also feature adequate wiring to architects and builders.

ALL NEW Public Utility Transportation Developments

GO WHITE 3000!

WHEN there is a new transportation development introduced in public utility service, the efficiency and economy standard is, of course, the White 3000.

The functional design, the weight distribution and the maneuverability of the White 3000 make it ideal for every kind of body . . . all applications.

Get all the efficiency engineered into your specialized transportation jobs with the White 3000—Tomorrow's Truck for today's specialized utility requirements.

NEW WHITE 3000 IN COLUMBUS!

COLUMBUS and SOUTHERN OHIO ELECTRIC CO., White user for years, now has these new White 3000's with "A" Frame pole-setting derricks. They are Model 3020 Whites with 127½-inch wheelbase, 9.00 x 20 tires, and White Mustang Engines. They have a new heavy-duty power-operated hydraulic derrick with an operating range of 195° and ability to load up to 5,000 lbs. on body with derrick.

. . . With the patented safety power-lift cab

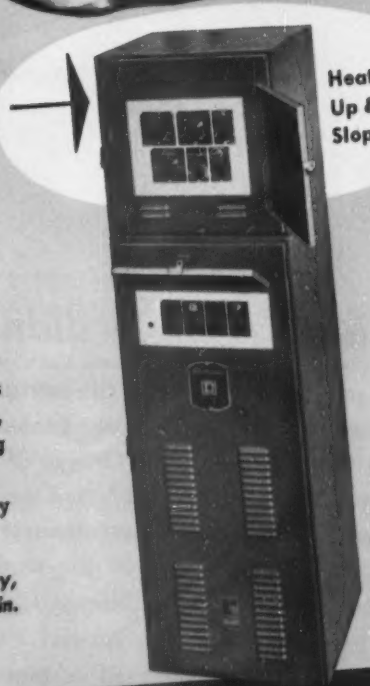
THE WHITE MOTOR COMPANY
Cleveland 1, Ohio

FOR MORE THAN 50 YEARS THE GREATEST NAME IN TRUCKS

Better Welding!

ONE TOUGH JOB
—three magnet frame pieces of different thicknesses, projection welded in one operation

Improved non-synchronous performance with Square D's NEW SLOPE CONTROL



Heat—
Up & Down
Slope

BETTER AND MORE PROJECTION WELDS through more uniform distribution of welding current.

PERMITS WELDING NON-FERROUS METALS. Reduced "spitting" at electrodes improves appearance of aluminum and other non-ferrous welds—extends electrode life.

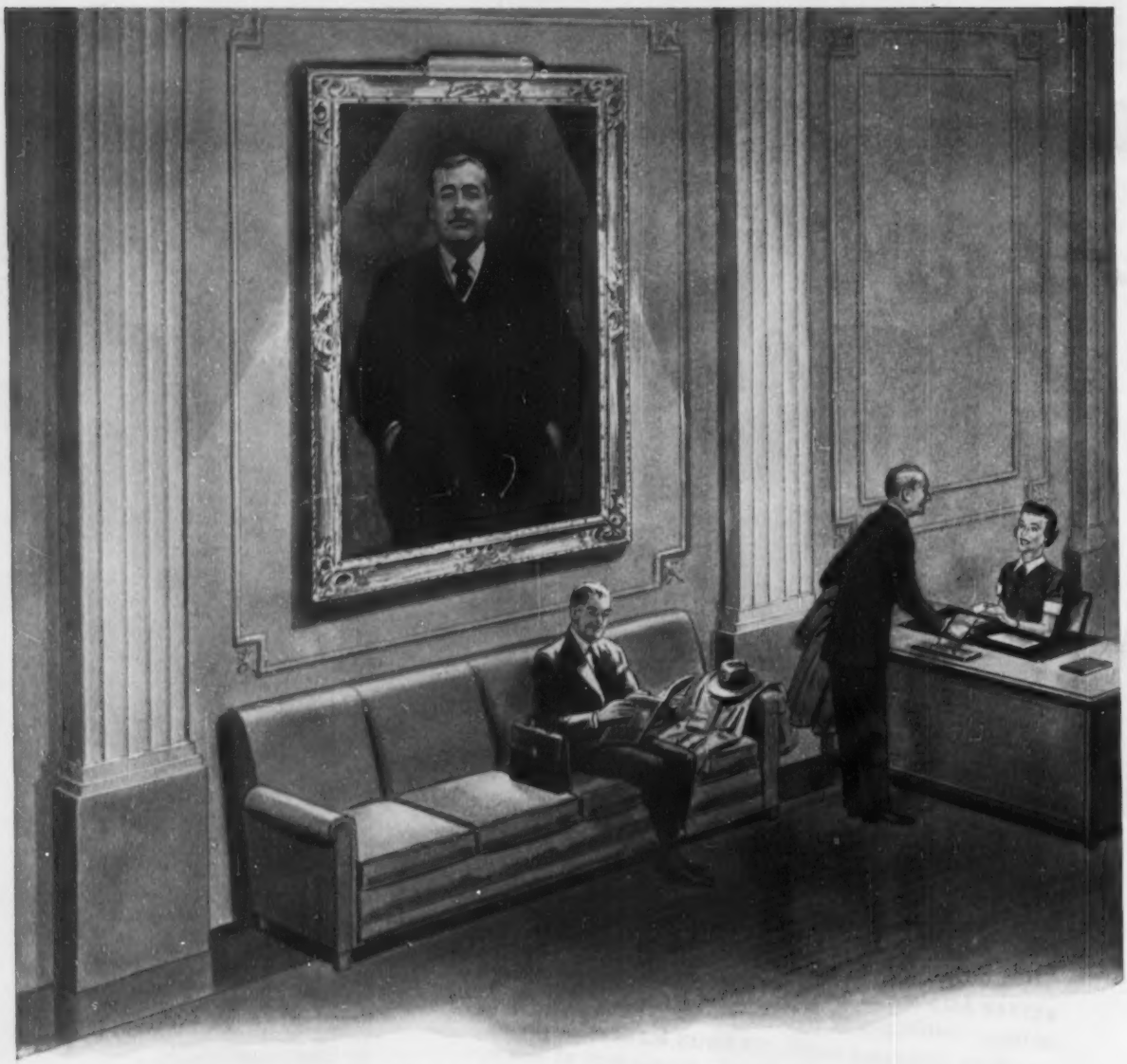
DESIGN FEATURES

Matched Enclosures. Slope Control enclosure matches Square D Non-Synchronous Welder Controller (Nema N2), shown at right. Also matches individual Square D welding timer or contactor enclosures.

Simplified Circuit, standard components, and heavy-duty construction.

Write for Bulletin 8990 EWG. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin.

SQUARE D COMPANY



Colonel Byllesby didn't know he was a pioneer . . . . .

It was before the turn of the century that young Henry Byllesby worked side by side with Tom Edison and George Westinghouse. As they each contributed their great knowledge to design the first steam operated electric central station in the world, the farthest thought from Henry Byllesby's mind was that someday he and Tom and George would be regarded as pioneers in electric power. It was therefore more than coincidence that the company he founded in 1902 should later be aptly named, Pioneer Service and Engineering. This is but a tribute to the vision of a man who, with his company, contributed to making America the most powerful nation on earth. This year Pioneer takes pride in celebrating LIGHT'S DIAMOND JUBILEE and pauses a moment to respect the name of its founder *. . . who didn't know he was to be a pioneer.*

52 YEARS

Serving power plant needs of utilities and private industries

Pioneer Service & Engineering Co. 231 SOUTH LASALLE ST. CHICAGO 4, ILL.

it's time for a new meter...

when the Wilsons...

buy an air-conditioner

The Wilsons have joined the thousands of American families whose growing demands for power obsolete the old two-wire meters that measure their loads. They will need a three-wire service to provide the voltage and capacity they now require.

The new Sangamo J2 three-wire meter, with its straight line accuracy up to 100 amperes, will measure this increased load and will provide for any contingency of future load growth.

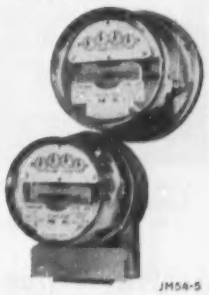
High thermal capacity and straight overload characteristics enable the J2 to measure accurately up to 100 amperes. Because of its high torque, the Sangamo J2 will also accurately measure light loads for many years without recalibration. The J2 is *the* slow speed meter that makes fewer revolutions per kilowatthour—bearings last longer.

When you invest money in meters you know are going to have to handle greater and greater loads, protect your investment by choosing a meter with plenty of reserve capacity. Choose the new Sangamo J2—the first . . . and finest . . . 15 ampere meter with 100 ampere capacity.

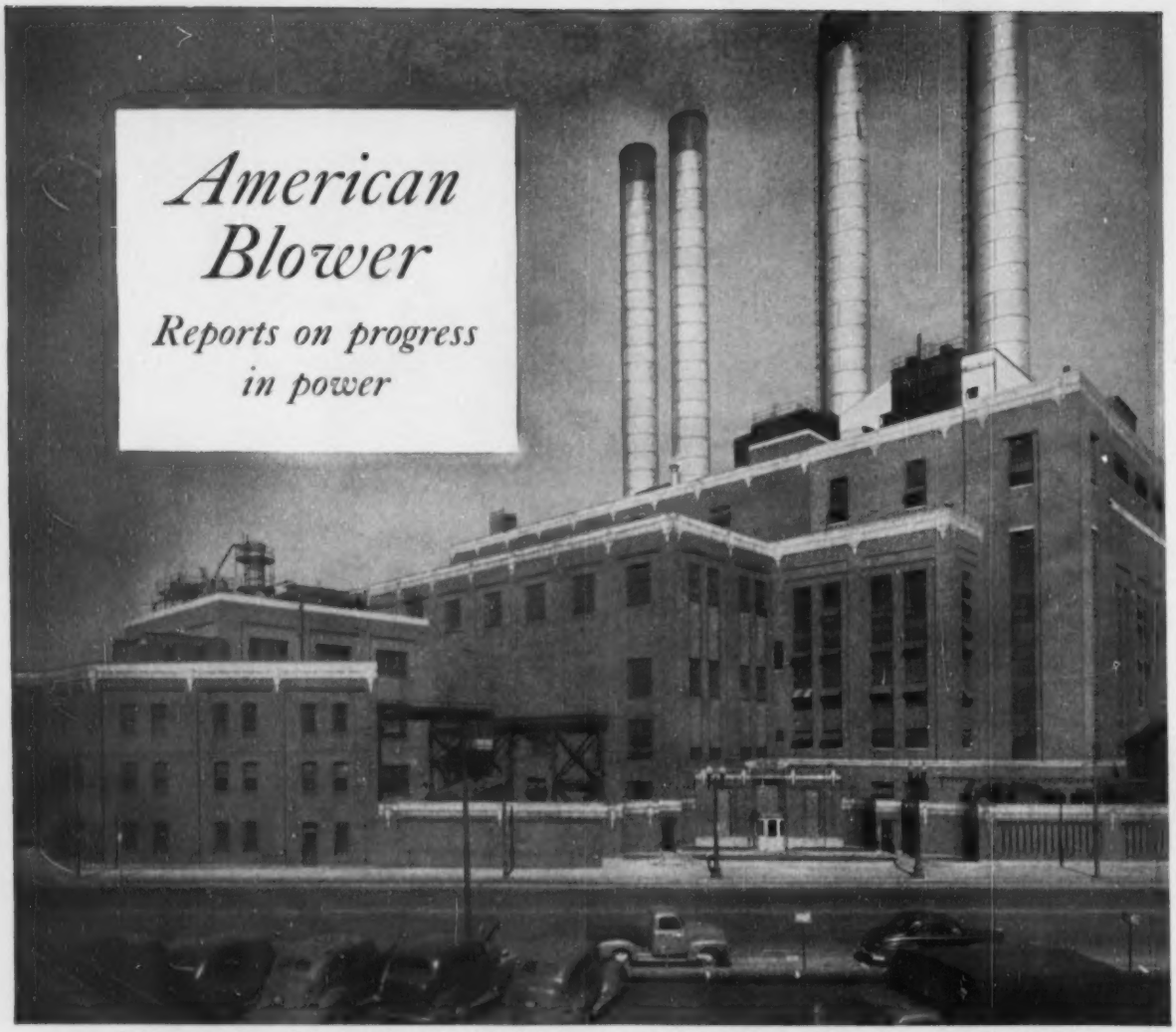
SANGAMO ELECTRIC COMPANY, *Springfield, Illinois*

A METER WITH STRAIGHT LINE ACCURACY

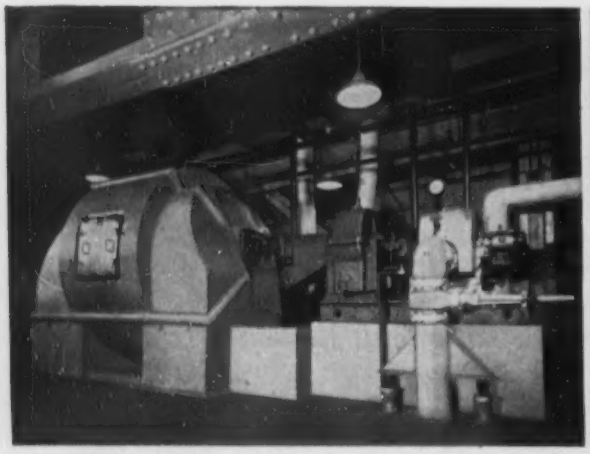
UP TO 100 AMPERES



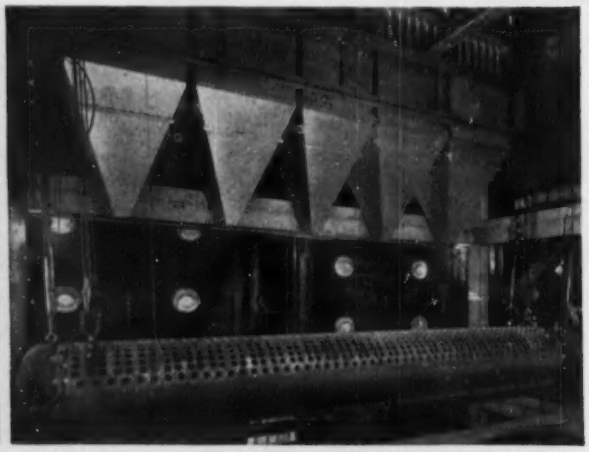
JM54-5



Impressive Perry K Plant (above) has installed capacity of 1,900,000 lbs. of steam per hour. Indianapolis Power & Light Company has four other plants of which the White River Plant is newest and largest.



One of the American Blower Induced Draft Fans at the Indianapolis Power & Light Company's Perry K Plant. Rated at design point for 200,000 cfm at 620° F., 730 rpm, with 9" sp.



Looking at #15 boiler area at Perry K Plant, you see IP&LC's American Blower Dust Collectors before operation. Each is rated at design point for 200,000 cfm at 620° F., with 4.25" sp.

Serving home and industry: **AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS &**

Indianapolis Power & Light Company expands with Indiana

Business, employment and population are constantly growing in the 528-square mile area in central Indiana served by the Indianapolis Power & Light Company. To keep pace, IP&LC will have invested $132,000,000 for modernization and expansion in the 12-year period from 1946 through 1957. Now, the five generating plants provide a generating capability of 530,000 kw, which will be increased to 635,000 kw by the installation of a sixth White River unit by the end of 1955.

A progressive, investor-owned utility, IP&LC strives to give better service . . . to keep capacity higher than the increasing demand for abundant, low-cost electricity.

Every year since 1946, IP&LC has expanded its facilities . . . and, at the same time, reduced the average price of a kilowatt hour! IP&LC credits this record partly to new methods of operation and efficient equipment – including American Blower Forced and Induced Draft Fans, Vaneaxial Fans and Dust Collectors.

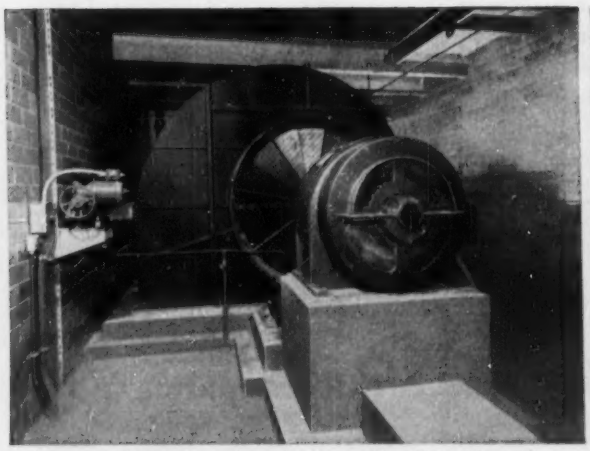
Power plant operators everywhere are specifying American Blower Mechanical Draft Fans, Dust Collecting Equipment, Fly Ash Precipitators and Gyrol Fluid Drive for boiler feed pump and fan control. They know they can depend on American Blower Equipment and technical assistance.

If you have an air handling problem, or plan to expand or modernize, contact your nearest American Blower Branch Office, or write us direct.

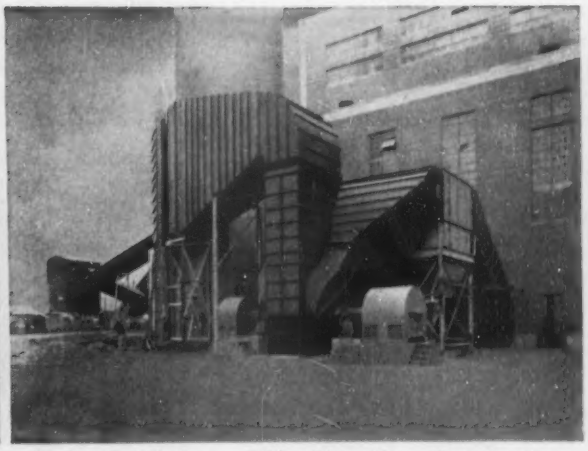
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER



American Blower Forced Draft Fan at the White River Plant. It is rated at design point for 190,000 cfm at 105° F., with 11.7" sp. Driving motor for fan develops 500 hp at 855 rpm.



Outdoor installation at White River Plant of an American Blower Induced Draft Fan. Rated at design point for 335,000 cfm at 380° F., with 14" sp. Driven by 1250 hp, 585 rpm motor.

WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

PRESENTS A SPECTACULAR ADVANCE *Thompson*

IN

RIGHT-OF-WAY BRUSH CLEARANCE

BROAD SPECTRUM BRUSH KILLERS

Fortified with patented H. S. 31 to deliver extra creep for extra kill.

Thompson Broad Spectrum 2,4-D—2,4,5-T brush killers set a new standard for ease of application, more effective killing action and more economical results in brush clearance. Now your crews need no special technical skills—they simply mix and spray. Hard woods—all species—brush or weedy growth—powerful broad spectrum Thompson brush killers of controlled volatility remove the hazard of "chancey" effectiveness. Foliage spray or basal bark application, you get more kill per gallon and more gallons for your dollars.

Thompson Chemicals

Latest technical data free. Write for station paper No. 12

Thompson **CHEMICALS CORPORATION**

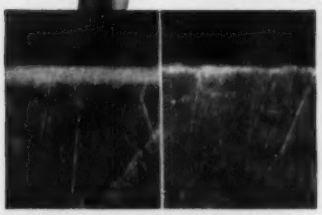
3028 Locust Street, St. Louis 3, Mo.
3600 Monon Street, Los Angeles 27, Calif.

representatives in principal cities

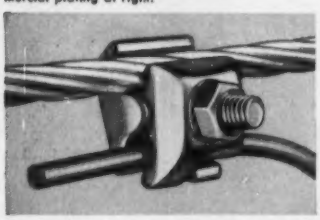
FIRST NAME IN BRUSH KILLERS

One AGP* clamp for all connections

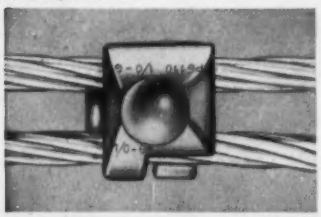
Protect your conductor with THE CLAMP THAT'S AHEAD OF THE TREND



Micro-photograph shows how high-density fortified cadmium, applied to a thickness of .001" on Chance AGP Clamps, compares with commercial plating at right.



Overlapping contacts on one side and a straight slide-in groove on the other help the attachment of the tap to the line.



Top view of clamp shows extra wide gripping jaws that contact all outside conductor strands in the entire size range.

Connecting copper and aluminum conductor requires a general purpose connector as good as the conductor itself in conductivity, mechanical stability and corrosion resistance, if future trouble on the line is to be avoided.

The best connector for this purpose is an aluminum bodied clamp with a *properly applied coating* of high density, fortified cadmium, proved best by every test for long-lasting, troublefree, general purpose connections.

That's what you get in the New Chance AGP Parallel Groove Clamp, companion to the widely tested and accepted Chance AGP Tap Clamp. The Chance PG110, shown above, can be used for any combination of aluminum or copper in a size range 1/0 ACSR to No. 6 copper *both sides*. This clamp is heavy in construction—yet light in weight. The high tensile strength bolt swivels into position without binding or bending. The wide jaws of this clamp contact every strand of any conductor in the entire size range. Rounded edges protect the conductor against damage from vibration.

Chance PG110 is your universal clamp for most applications. Larger sizes with the same features are also available. Write for complete information.

***Aluminum General Purpose**

FORTIFIED CADMIUM ...proved best by test for joining aluminum and copper conductors

Read these Statements!

They're from leading manufacturers of aluminum conductor, power companies, and research laboratories. (Names on request).

* * *

"Where outdoor weather resistance is required, *cadmium is the best metal to deposit on aluminum.*"—Laboratory.

* * *

"This is the most logical solution to the problem of making aluminum to copper connections."—Conductor Manufacturer

* * *

"All factors considered—corrosion, electrical requirements, service—cadmium plated aluminum connectors, plated according to the method used by the Chance Company, are the best possible combination for use on aluminum conductor, for aluminum or copper taps."—Conductor Manufacturer

* * *

"Your AGP connector, cadmium clad as you do it, is going to solve one of our greatest problems of making lasting A and C connections."—Power Company

* * *

"The value of cadmium plated coatings has been completely demonstrated. Their high resistance to atmosphere, corrosion, to salt spray and to alkali has made them outstanding as a corrosion-resistant coating."—Laboratory.

* * *

"I prefer cadmium because of its outstanding resistance to corrosion in contact with aluminum and because of its inherent low contact resistance."—Conductor Manufacturer

* * *

"Our research laboratory found an average cadmium coated thickness of .002" on your AGP clamps. This is considerably more than the .0005" coating implied by ASTM specification A-165 Type N.B."—Aluminum Manufacturer

* * *

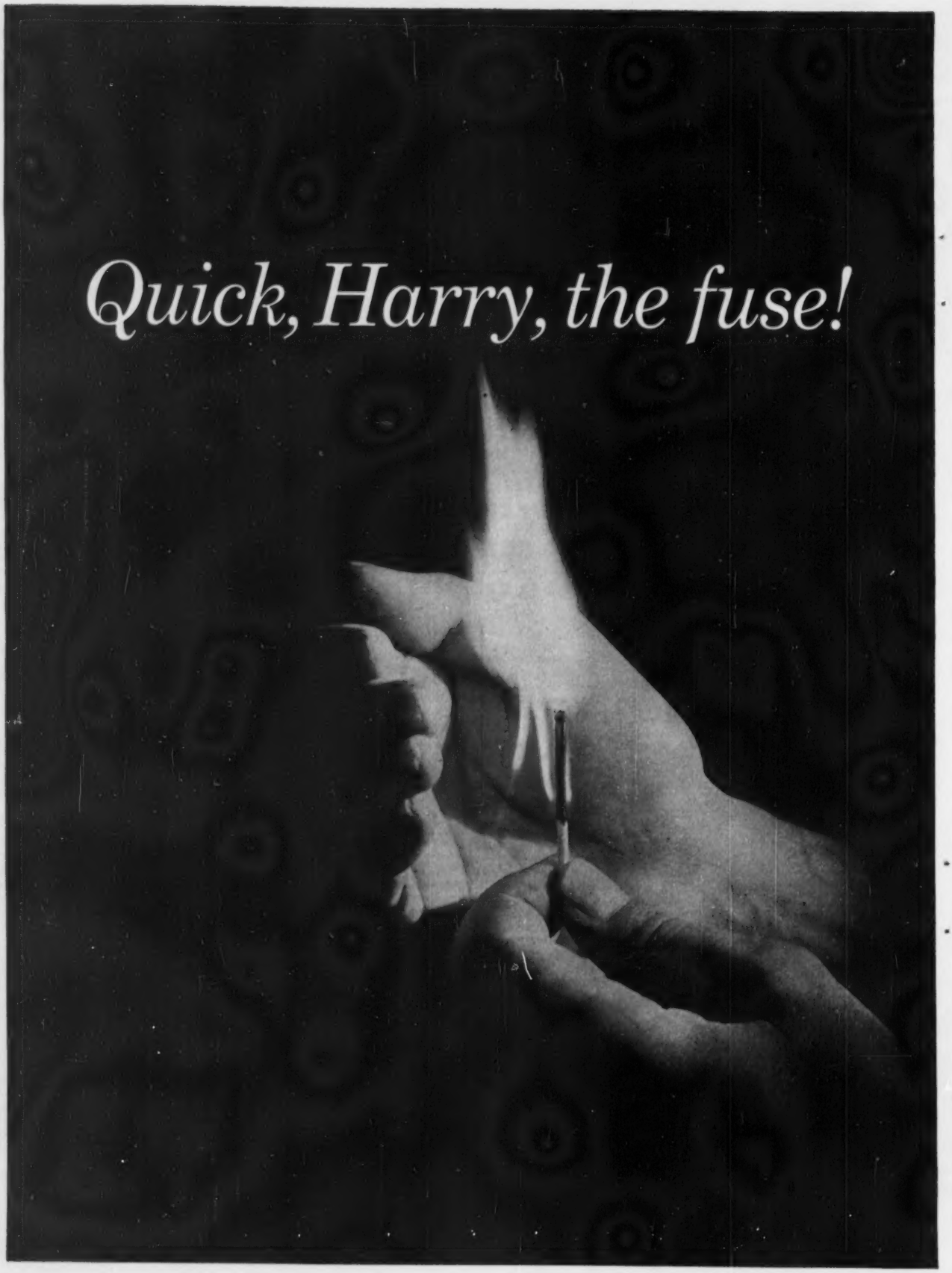
"Your AGP clamps were subjected to approximately 500 hours in a humid sulphide atmosphere and after cleaning to remove the sulphide coating which had formed on the exterior they showed no evidence of a breakdown of the fortified cadmium plating."—Eastern Utility

ABC INDUSTRIES

A·B·CHANCE CO·

CENTRALIA, MISSOURI
SAN FRANCISCO, CALIFORNIA

CC50-11


Quick, Harry, the fuse!

Ten minutes 'til dinner. You've got your coat off, the evening paper,
and you're just about to sit down in your favorite easy chair . . .

Bingo! The lights go out in the kitchen, and that woman with whom you once
said you could never live without, lets out a blast — "Quick, Harry, the fuse!"

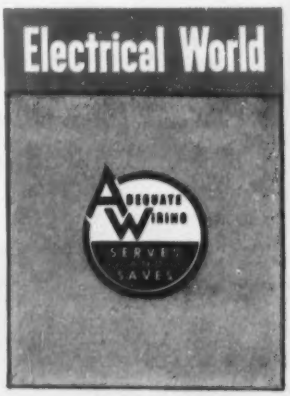
Where's the flash light? Aw, the heck with it! Use matches.
Down the cellar you go. Where is it? Watch out! Don't burn your fingers.
That's it. Now where'd you leave those new fuses?
Come now, Harry, you didn't forget to buy them?

Ever happen to you? It happens every day to people who live
in anemic homes. Yes, *anemic*. Never heard a house called that before,
have you? The electrical industry has another term for it.
They call it "*inadequate wiring*."

Your electrical circuits are the blood circulation system of your home —
carrier of light, heat, power. If your home has too few circuits —
not enough heavy duty lines for range, dishwasher, air conditioner — is lacking
in convenience outlets in kitchen, bath, living room, bedroom —
is short-changed on switches . . . well, these are some of the basic symptoms
of electrical anemia.

How adequately wired is your home? Or that new home you're thinking of buying?
Talk to your lighting company. Get their counsel. No, they don't have
anything to do with the wiring *inside* your house, but they are concerned
with how economically and efficiently you utilize the electric power they carry
to your meter. Or, if you prefer, write us for your free copy
of "*Getting the Most From Your Home's Electrical System*."

This message is one of a series currently appearing in magazines reaching more than a million readers — businessmen and homeowners. It is sponsored by Electrical World for the most unselfish-selfish reason — what is good for the electric power industry is good for the publication that has served it continuously for 80 years.



A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, NEW YORK • ABC • ABP

JOSLYN

Secondary Pulley Bracket

Here is a single-point secondary bracket especially designed for use as a stringing pulley—as well as a secondary bracket—making it particularly useful for stringing and sagging secondary conductor.

The 90° slot in the bracket base makes it possible to rotate the bracket into the "pulley" position—

or the bracket position—on the head of the thru bolt. The transition from one position to the other is accomplished by merely loosening—not removing—the thru bolt.

Install the bracket initially in the "pulley" position. String and sag the conductor. "Tie in" the conductor to each spool before or after the bracket is switched from "pulley" to bracket position.

A close fit between insulator and bracket is maintained. The conductor cannot "bind" during the sagging operation.

A cleverly fashioned metal tab on the bracket's upper arm makes possible the removal of the insulator bolt during the wire stringing operation, or for insulator replacement. The tab is easily moved with lineman's pliers. This unusual feature eliminates the conventional cotter key.

STOCK NO. J252

Write for further details

Complete Line Equipment

JOSLYN Mfg. and Supply Co.

20 North Wacker Drive, Chicago 6, Ill.

• Branch Offices in Principal Cities

The Joslyn Co. • The South East Joslyn Co. • Southern Joslyn Co. • Joslyn Southwest Co. • Joslyn Pacific Co.

WHY IT PAYS TO BUY SPECIALTIES FROM US

You get quality products, fast delivery—*anywhere*

TRIPLE SECURITY

What you want
When you want it
At the **right price**

• Maybe you didn't know it, but U. S. Steel Supply can supply you with everything you need in the way of industrial supplies, as well as with the *steel* you need.

Call us for—Dardelet Rivet Bolts, High Strength Bolts, Blakled (a new rust-inhibiting material), Grinding Wheels, expanded metal, chain and chain slings, welding electrodes, welding machines, clamps, Markal Paintstiks, Galv-Weld (for regalvanizing welded areas), mechanical rubber goods—conveyor belts, transmission belts, all types of hose, V-Belts, structural fabricating machinery, sheet metal machinery.

These items are carried in stock ready for immediate delivery. For complete information and literature, fill out the coupon below and send to us.

U. S. STEEL SUPPLY
DIVISION

General Offices
208 So. La Salle St., Chicago 4, Ill.

USS

Warehouses and Sales Offices
Coast to Coast

U. S. Steel Supply Division
208 So. La Salle St., Chicago 4, Illinois
Gentlemen:
Please send me your free literature describing the following items:

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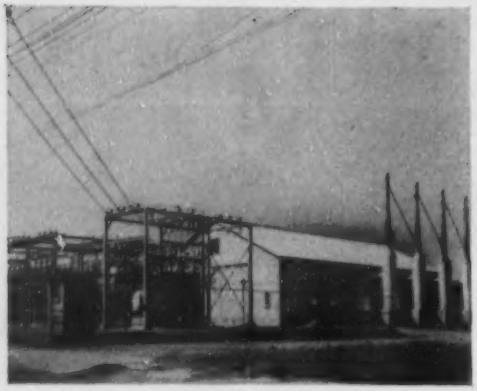
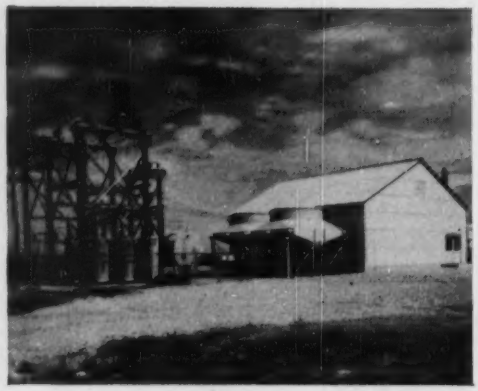
....

Name.....
Company.....
Address.....
City..... State.....

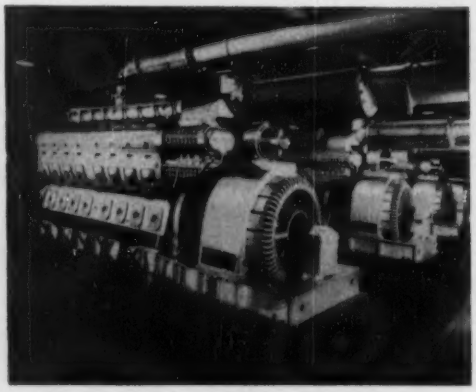
UNITED STATES STEEL

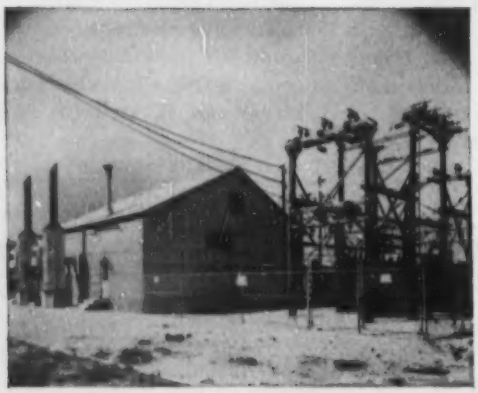




BE A SATISFIED CUSTOMER

For one customer alone, Pritchard has fulfilled contracts for 11 different diesel power installations. Such repeat contracts mean satisfied customers . . . are the best proof that Pritchard customers receive the design and construction skills, diesel know-how, and dependable services that are needed to produce modern, efficient installations.





Industry's Partner for Progress

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 389, 210 West 10th St., Kansas City 5, Mo.

CHICAGO • HOUSTON • NEW ORLEANS • NEW YORK
PITTSBURGH • ST. LOUIS • TULSA

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

Getting the most from automatic protection in growing systems

50,000 miles of transmission lines—300,000 miles of primary distribution lines.

That kind of mileage, installed by utilities since 1951, is evidence of system growth to meet this country's expanding power needs.

J. K. Dillard, left, is a Westinghouse utility engineer who specializes in helping utilities solve expansion problems. He will present on the following eleven pages, some pertinent facts about automatic protective equipment.

Specifically, the next two pages discuss important aspects of microwave and power line carrier. Let's see what Carl Suhrstedt, Manager, Carrier-Microwave Sales, has to say.

Carl Suhrstedt (right), Manager of Carrier-Microwave Sales.

Microwave and power line carrier . . . flexible, dependable protection for growing systems

We think you will agree that modern microwave and power line carrier equipment can go a long way toward simplifying the protection problem of today's growing electric systems. Two prime factors in doing this job are flexibility and dependability under all conditions.

Westinghouse Type FR-FJ 2000 mc microwave is flexible because of its ability to handle your initial needs adequately and accommodate changes and expansion as your system grows. For example, telegraphic units are easily coordinated with protective relaying, telemetering, supervisory control, and all other end-use devices. They can be changed from one function to another with *no* equipment changes, additions or modifications. The FR-FJ microwave offers 30 voice channels, each of which can be used for as many as 15 telegraphic functions. For maximum dependability, multiplex panels are entirely self-contained—even including their own power supply.

Thousands of successful Westinghouse power line carrier installations prove its dependability. Current regulators, an exclusive Westinghouse feature, protect the vacuum tubes from station battery voltage fluctuations—eliminating premature failures. Building block construction provides the flexibility you need for future changes or expansions.

An important added benefit is the fact that Westinghouse not only manufactures both carrier and microwave but also produces a completely coordinated line of end-use equipment.

On the following page, O. C. Green, Relay Design Engineer, reports on a significant relay protection feature.

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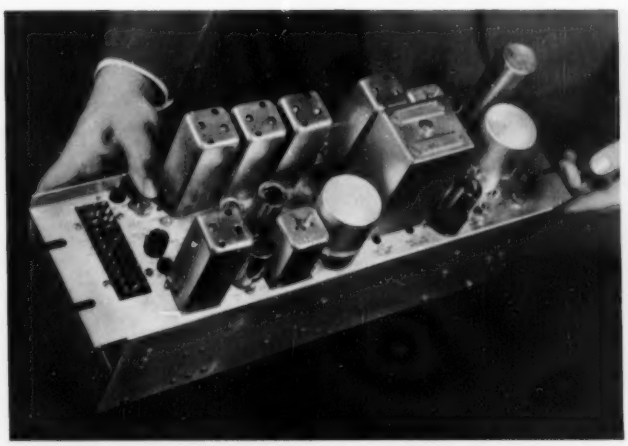
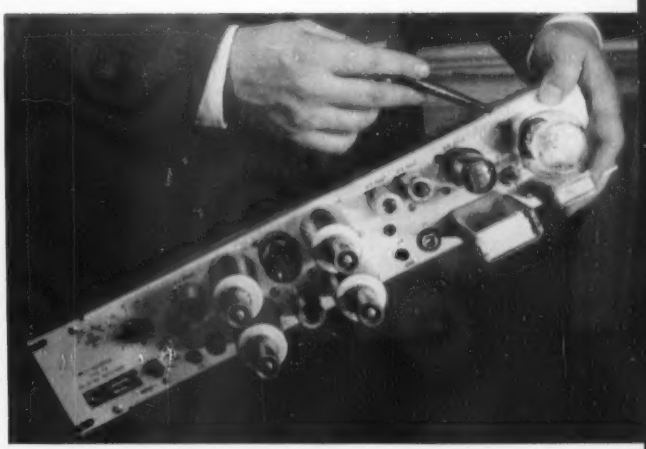
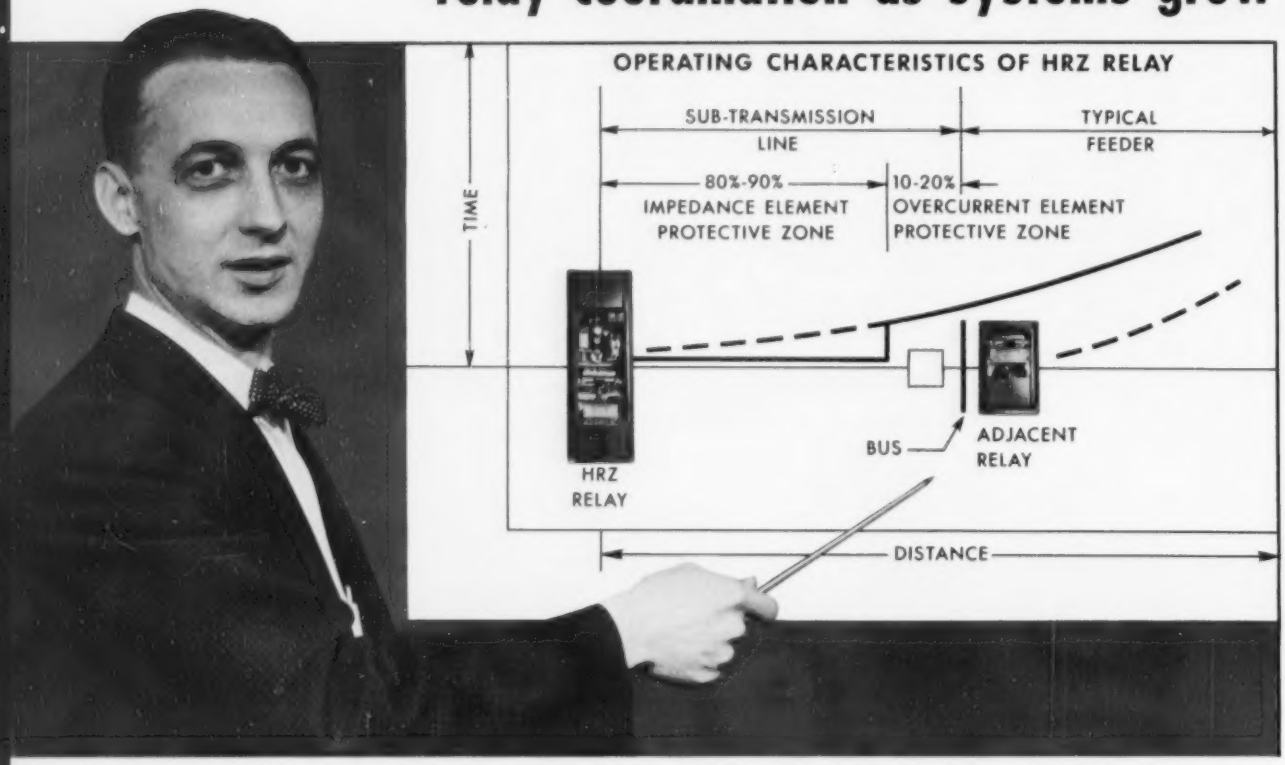


Microwave Type FJ voice band panel. Completely self-contained unit provides a channel independent of all other channels. Panel is adaptable to all types of telephone service and signaling.



Carrier relay receiver includes a current regulator which makes possible use of station batteries without the voltage fluctuations so damaging to vacuum tube efficiency.

New HRZ relay simplifies relay coordination as systems grow



On the chart above, O. C. Green, Relay Design Engineer, shows how the HRZ relay provides the high-speed protection required for transmission lines, yet closely duplicates the time-curve of adjacent overcurrent relays, giving back-up protection without danger of false tripping for faults in the feeder.

As a system becomes larger and more complex, there is a growing need not only for high speed relaying but also for improved coordination between relays installed on sub-transmission lines and those installed on feeder circuits.

To do this, the Westinghouse HRZ relay was developed, combining a high-speed impedance element with an induction disc overcurrent element in a single-phase relay. The impedance element provides instantaneous protection for 80-90% of the line section. Protection for the remaining 10-20% is provided by the overcurrent element. For effective coordination with relays on adjacent sections, the HRZ overcurrent element can be supplied with definite minimum time, inverse or very inverse characteristics. Simplified adjustment on the new "E" design of the overcurrent element assures easy match-up of operating characteristics.

High-speed operation minimizes serious line damage, while selective coordinated operation assures reliable service. The HRZ relay may be applied economically where more expensive equipment cannot be justified. For these reasons, it is especially suitable for addition to growing systems.

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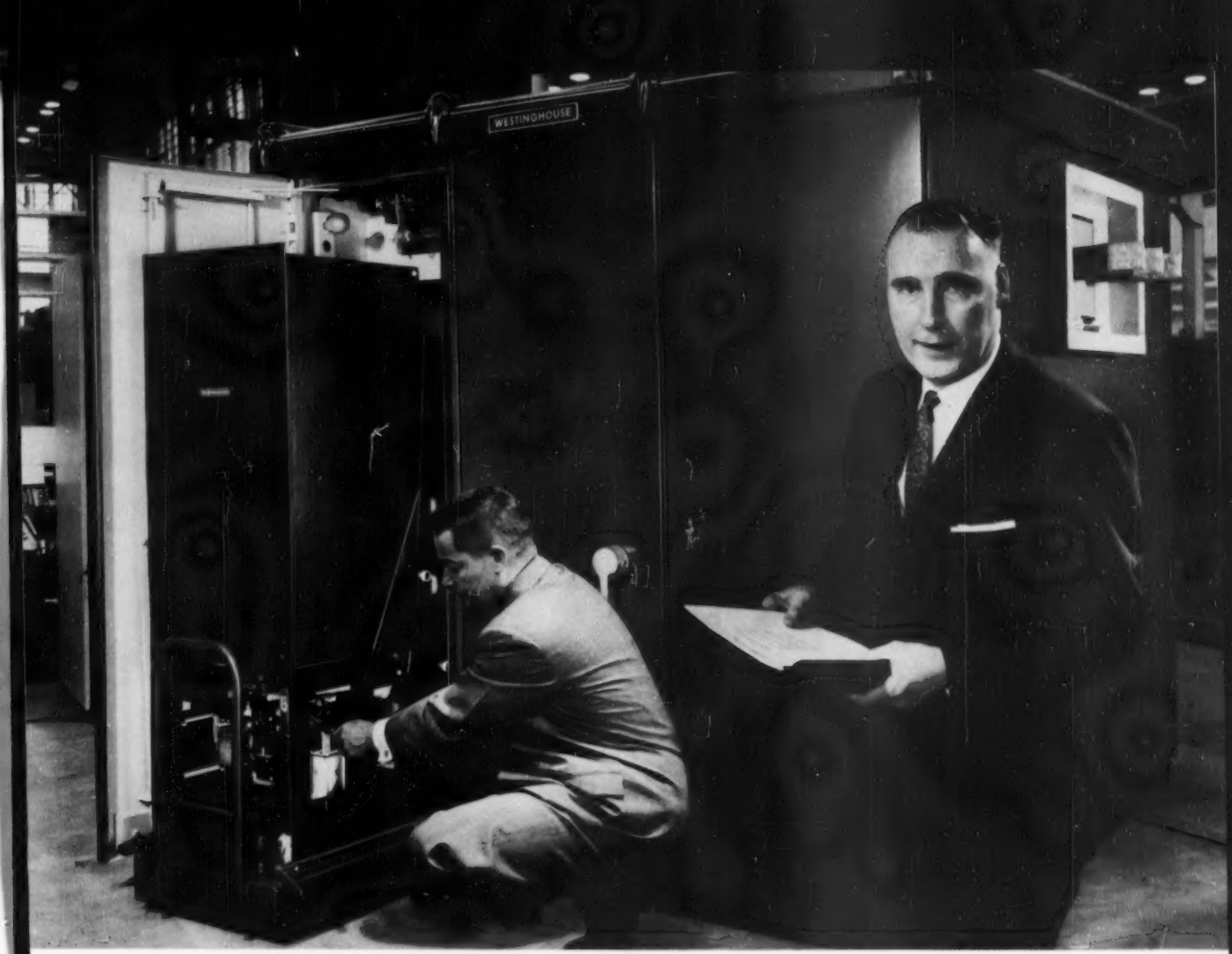


Wally Payne (right), Manager of Switchgear Assembly Sales, and J. K. Dillard, Utility Engineer.

Standardized switchgear solves system expansion problems

Westinghouse metal-clad switchgear is designed to minimize or eliminate some of the problems associated with system expansion.

Maximum Service Continuity: Because this switchgear has unitized construction and is standardized in design, additional feeders can be added with minimum outage time. Full service is afforded to existing loads except for the short time required to tie in the main and control buses.

High Level of Protection: Westinghouse metal-clad switchgear components are engineered to work and fit together from the design stage through manufacturing, thus assuring the full coordination necessary for a high level of protection.

Maximum Salvage Value: The load capability of metal-clad switchgear can be readily adapted to accommodate load growth and shifting load centers. The entire assembly can be moved easily, quickly.

There are other benefits to Westinghouse standardized metal-clad switchgear, such as low installation costs, greater safety, pleasing appearance, ease of inspection and maintenance, and others that give you assurance of continuing protection—regardless of your growth pattern.

Speaking of advantages in automatic protection, *Les Livingood of New York State Electric and Gas* and *Bob Ray, Westinghouse Distribution Transformer Sales Manager*, discuss convincing service data on distribution transformers on the next two pages.

Les Livingood (left) of New York State Electric and Gas, and Bob Ray, Manager Distribution Transformer Sales.

On this growing system, automatic transformer protection cuts outages 28 to 1

This vastly improved service record, as compared with conventional transformer experience, is being enjoyed by New York State Electric and Gas. It could apply equally well to your growing system. Built-in arresters and protective links, combined with the protection of the breaker built into "CSP"® transformers, are largely responsible.

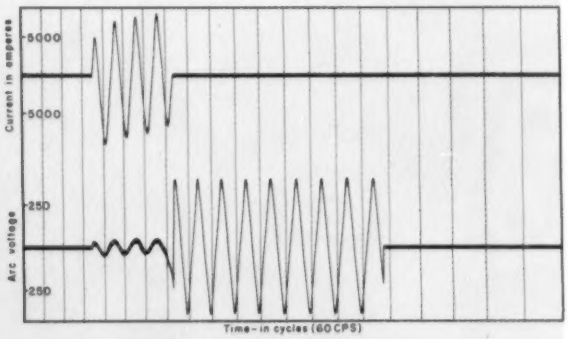
One of the big reasons for the success of the "CSP" transformer is that the breaker is actuated by variations in actual copper temperatures instead of by just oil temperature or magnitude of current. As an integral part of the transformer, it gives your growing system better protection against service outages in two ways:

First, a signal light actuated through the breaker warns that the transformer has reached its maximum safe operating temperature. The signal light thus provides a convenient means of making continuous load surveys. The need for replacement with larger transformers can be recognized long before service outages occur.

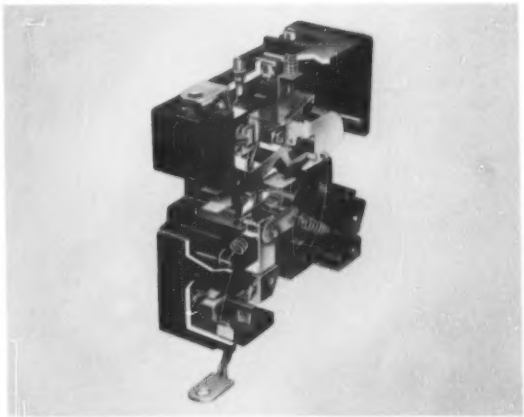
Second, if a serious overload does trip the breaker —service can be quickly restored. No fuses to replace. Unnecessary service trips are eliminated because the breaker will trip out only on those overloads that exceed the transformer's thermal capacity. Nondamaging, short-time overloads are carried.

Built-in LX-T lightning arresters, LR breakers and protective links, all coordinated specifically to the "CSP" transformers to which they are applied, give you complete, automatic protection . . . economically. Plan now to get the extra protection of Westinghouse "CSP" transformers for your system.

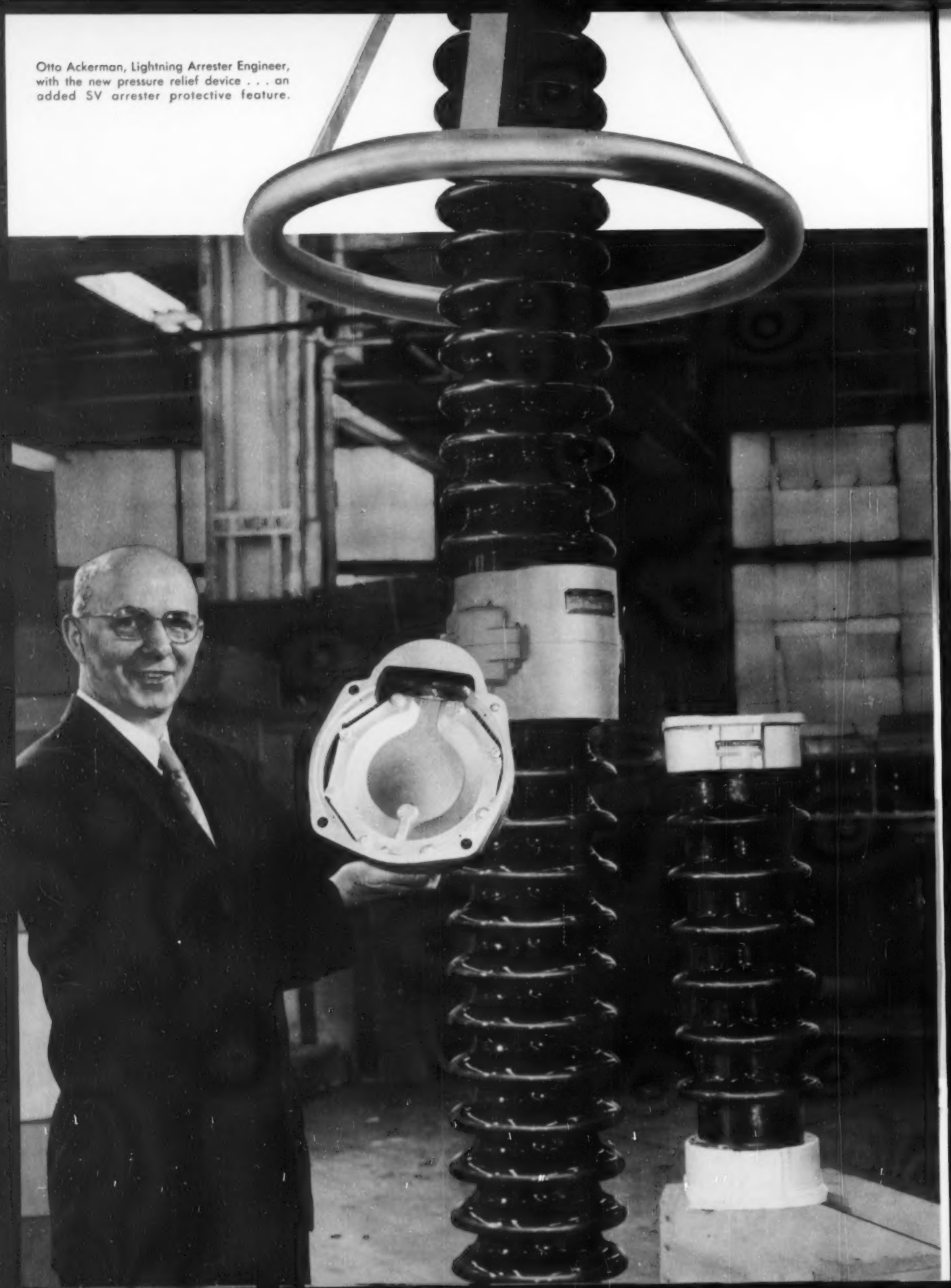
If you're interested in the latest in lightning arrester design, Otto Ackerman, Lightning Arrester Engineer, has something new to show you on the next two pages.



The above oscillogram of a short-circuit test on the LR breaker is typical of its speed in interrupting current with minimum arcing. Consistent interruption of 5000 amps in 4 cycles is high speed protection.



LR breaker cutaway. The controlling factor in the LR is a bimetallic element. The action is determined directly by copper temperature. This is the most accurate means of overload and short-circuit protection available.



Otto Ackerman, Lightning Arrester Engineer, with the new pressure relief device . . . an added SV arrester protective feature.

Proved protection in station and line arresters now greater than ever

Operators have proved to themselves that Westinghouse SV (station) and LVS (line) arresters have high protection capability. Recent new features offer your system even greater protection—without changing the proved basic design. Here's how:

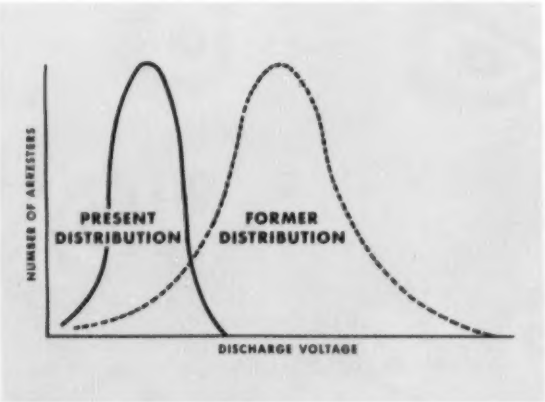
New Pressure Relief Device in the SV arrester eliminates the possibility of an internal short circuit ever causing gas pressures to rise high enough to burst the porcelain—with resulting danger to adjacent equipment. This is accomplished by a unique diaphragm and gas venting system which instantly transfers the gas outside the arrester—before the porcelain can burst.

Lower Discharge Voltages give you the greatest protective margins available in high-capacity arresters. (See charts below.) This was achieved through improvements in the entire sequence of Autovalve® block manufacturing and test procedure.

Lower Impulse Spark-over values for the LVS have been accomplished without reducing the 60-cycle sparkover values. The proper balancing of these two values assures you of protection and a safe margin for clearing follow currents.

There are many other proved features of Westinghouse SV and LVS arresters such as an exclusive moisture-proof solder seal and aluminum alloy end castings which add up to the best protection available for your growing system.

For a discussion by *Jack Stirling* of the *Switchgear Division* on the outstanding Type AA mechanisms, turn the page.



These curves show the comparison of former and present distribution of the discharge voltages of Autovalve lightning arresters. Note the reduction in limits, resulting in lower discharge voltage characteristics throughout.

Maximum discharge voltages, kv crest, for the following discharge currents in amperes crest, 10 x 20 microseconds

Arrester Rating Kv Rms	1500	5000	10000	20000	100000
		SV ARRESTERS			
12	29	34	37	40	50
30	73	85	93	100	125
73	178	206	225	245	305
195	475	550	595	645	810
		LVS ARRESTERS			
12	35	41	45	50	
30	86	101	112	124	
73	220	262	290	320	

This table shows you how maximum discharge voltages of Westinghouse SV and LVS arresters have been lowered to give you the greatest protective margins available in high-quality arresters.

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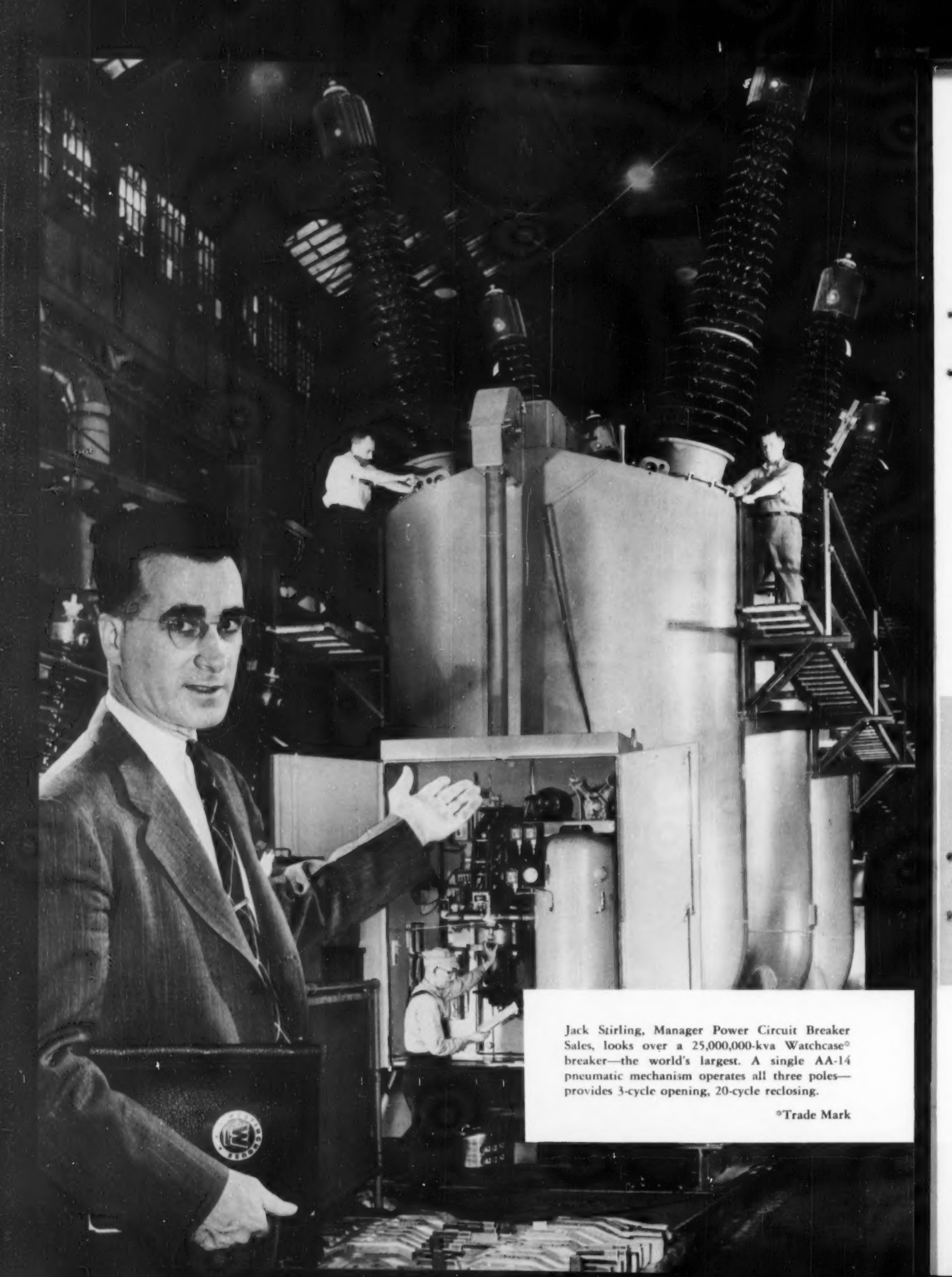


Jack Stirling, Manager Power Circuit Breaker Sales, looks over a 25,000,000-kva Watchcase* breaker—the world's largest. A single AA-14 pneumatic mechanism operates all three poles—provides 3-cycle opening, 20-cycle reclosing.

*Trade Mark

Type AA pneumatic mechanisms—better, faster breaker operation

In every way, Westinghouse Type AA pneumatic mechanisms are meeting the need, *better*—for the high interrupting capacity—high speed breaker operation demanded by system growth and interconnections.

They are better because:

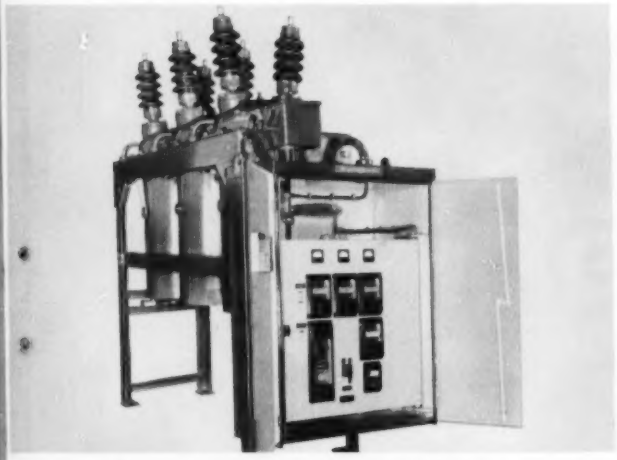
- **They are mechanically trip-free in all positions.**
- **They operate at low air pressures—70 to 270 psi.**
- **Operating accessories are time-proved in this pressure range.**
- **A single mechanism operates 3 poles simultaneously.**

An exclusive trip selector is the key to the high speed breaker operation—*under all conditions.* It provides, automatically, either mechanically trip-free or nonmechanically trip-free operation, depending on whether or not there is compressed air in the cylinder. This assures non-retarded opening at all times, initially, following a closure, or when closed in on a fault. This unique selector also provides ultra-high-speed reclosing without hammering of oppositely moving parts in either the breaker or the mechanism.

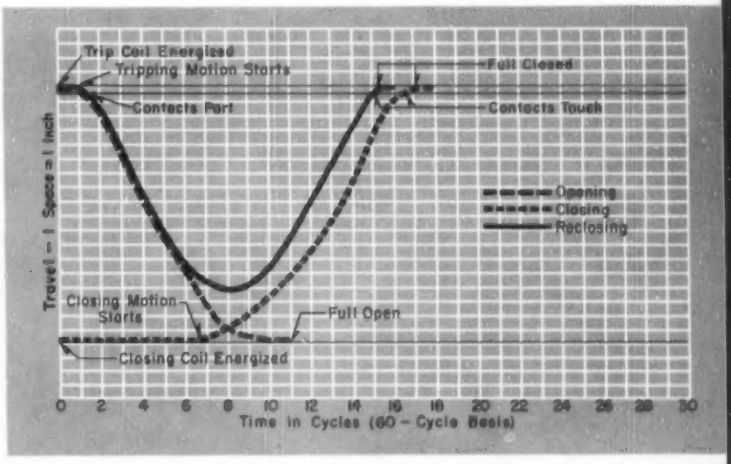
Operating accessories such as pressure switches, valves and compressors have been perfected in over 15 years of Westinghouse experience with pneumatic mechanisms. This, coupled with the low operating pressure, insures long, maintenance-free service.

The simultaneous operation of all *three* breaker poles by one mechanism is characteristic of the three Westinghouse Type AA mechanisms—AA-7, AA-10, AA-14. This greatly simplifies high-speed relaying schemes.

These outstanding pneumatic mechanisms attest to this fact: no matter how large your future loads or how difficult your operating requirements may be, you can count on Westinghouse to provide the circuit breakers to handle them.



An AA-7 pneumatic mechanism operates this 34.5-kv breaker. Protective and reclosing relays, mounted on a hinged panel, may be mounted in the housing to provide completely automatic operation.



This chart shows typical opening, closing, and reclosing performance of high voltage breakers using a Type AA-10 mechanism. Note the smooth reversal of travel on the reclosing operation.

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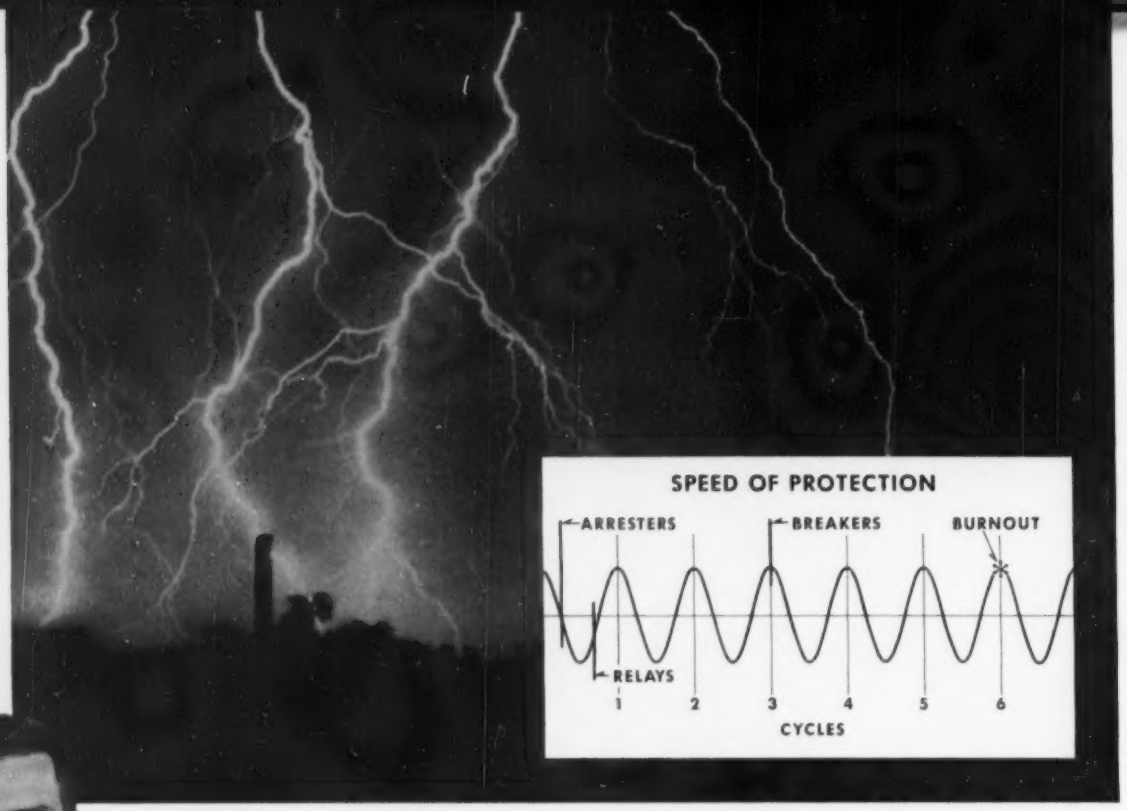

Speed—its importance to today's systems

We all agree that speed of protection is essential to modern electric utility systems—particularly under conditions of high transmission and distribution voltages. Perhaps we take it too much for granted.

A 10-million-kva fault at 138 kv, for instance, contains 41,000 amperes and can burn a line down in approximately six cycles or less. Less dramatic, *but vital,* is the fact that Westinghouse circuit breakers open within 3 cycles after a trip signal.

Even faster, Westinghouse high-speed relays trip for heaviest faults *in less than one cycle.* Or, faster yet, Westinghouse lightning arresters do their job in one ten-thousandth of a second after lightning strikes!

When you stop to think about it, speed is important to your system. It's a prime objective for Westinghouse research engineers. They work constantly toward even greater speed in Westinghouse equipment. You can be assured that as your needs grow, Westinghouse will be in a position to meet them.

CP-1020

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There's more detailed information available . . .

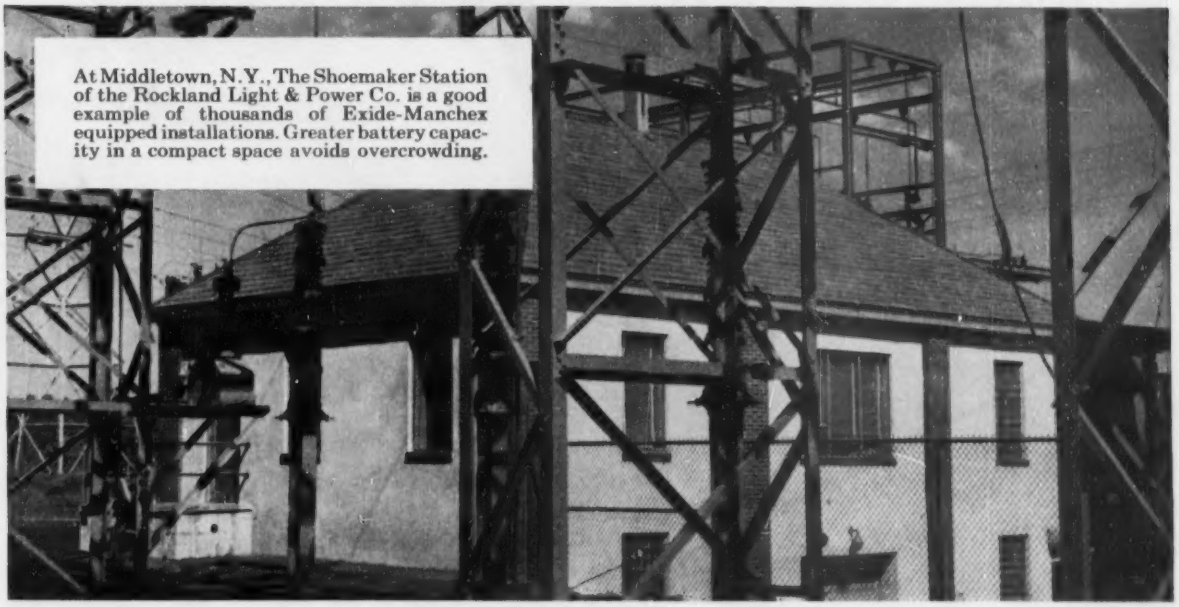
by getting in touch with your nearby Westinghouse representative. Or, if you prefer, write direct to Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. Product booklet reference numbers are as follows:

- ☐ Microwave—Power Line Carrier **B-5873, B-5850**
- ☐ HRZ Relays ..... **IL 41-421.1**
- ☐ Power Circuit Breakers **B-5904**
- ☐ Metal-clad Switchgear **B-5306-A**
- ☐ CSP Distribution Transformers **B-4249A**

CP-1020

GET LONGER BATTERY LIFE, LOW DEPRECIATION

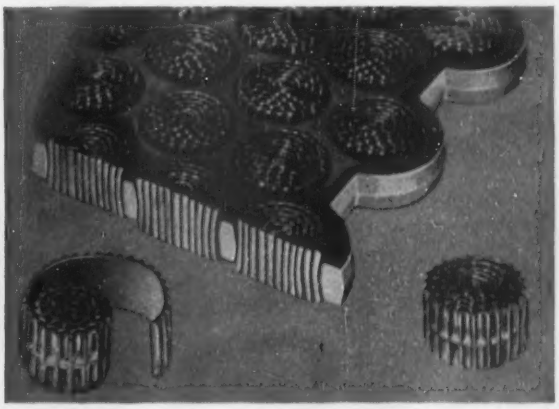
. . . with Exide-Manchex dependable power!



At Middletown, N.Y., The Shoemaker Station of the Rockland Light & Power Co. is a good example of thousands of Exide-Manchex equipped installations. Greater battery capacity in a compact space avoids overcrowding.

YOU CAN assure positive operation of switchgear and have an adequate reserve of power for all other control circuits and emergency lighting with Exide-Manchex batteries. Operational failures can be avoided; ample voltage is always standing by. Lower costs of operation, maintenance and depreciation make Exide-Manchex your best battery buy *for all control and substation services.*

THESE NEW EXIDE-MANCHEX 60-EME-17 batteries replaced the original order which had been installed in July of 1928, *twenty-six years ago,* in the Shoemaker Station. Assure dependable power, easy maintenance (water is needed only about twice a year) by buying Exide-Manchex batteries. For full details, call your Exide sales engineer—write for Form 5001 (Engineering and Maintenance Manual).



THE POSITIVE PLATES are the heart of any battery. Only Exide uses the famous manchester positive plates with buttons of active material. These buttons, inserted in a strong alloy grid, assure you of *high capacity* in a compact space, with an *unusually long battery service life.*

Your best battery buy . . . for all control and substation services

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MANCHEX® BATTERIES

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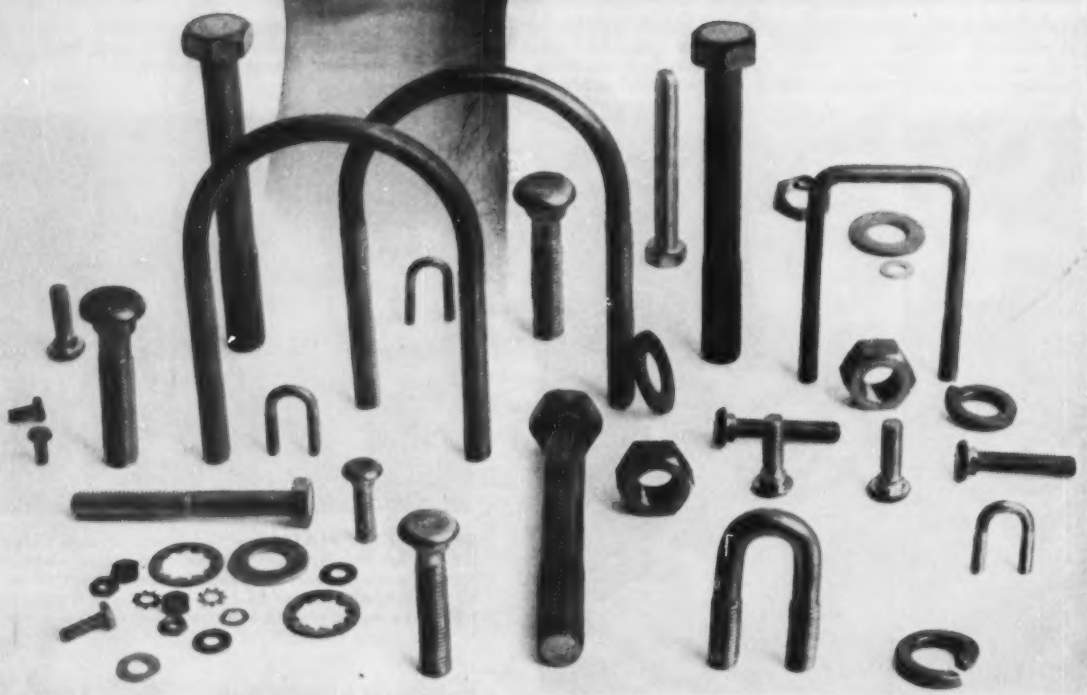
—how much better can it be? Plenty. When it's made by Burndy, it's made of Durium, the corrosion-resistant silicon-bronze alloy; *cold-worked* for extra strength; the threads are *rolled* instead of cut, to *retain* the strength; the cold-worked heads are properly fused to shanks, with fillets that prevent cracks at junction of shank and head.

Burndy bolts — nuts — washers — *all* help to insure tight, strong, corrosion-free connections with *low* contact resistance.

Quick delivery on all orders... anywhere in the U.S.A.... from large warehouse stocks.

For complete catalog and prices, call nearest Burndy representative listed in phone book, or write to Burndy headquarters.



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54-15

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Simplify those HARD-TO-HANDLE installations with U. S. GRIZZLY Pre-assembled Aerial Cables

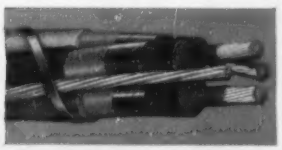
Check the following advantages of U.S. Grizzly® Pre-assembled aerial cables over ordinary open-wiring installations.

1. Less tree trimming is required, and therefore is less objectionable to the community. Can usually be installed in a more direct route.

2. Longer spans and fewer poles due to messenger's great strength.

3. Better appearance because of the elimination of cross-arms and less congestion at the poles.

4. Better service continuity because of high strength supporting messenger.



U. S. Grizzly pre-assembled aerial cable, 15,000 volts. Type RR —3 conductor, Uskor-ona® ozone-resistant insulation — shielded — Neoprene jacket.

5. Better voltage regulation because the conductors are bound closer together.

6. Lower installation and maintenance costs.

7. Permits shorter poles.

8. Made by United States Rubber Company, specialists in electrical insulation, the only electrical wire and cable producer to grow its own natural rubber, make its own synthetic rubber and manufacture its own plastics.

For more information, write to address below.

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Write for your copy of free booklet giving full information about U. S. Electrical Wires and Cables for the Electric Utility Industry.

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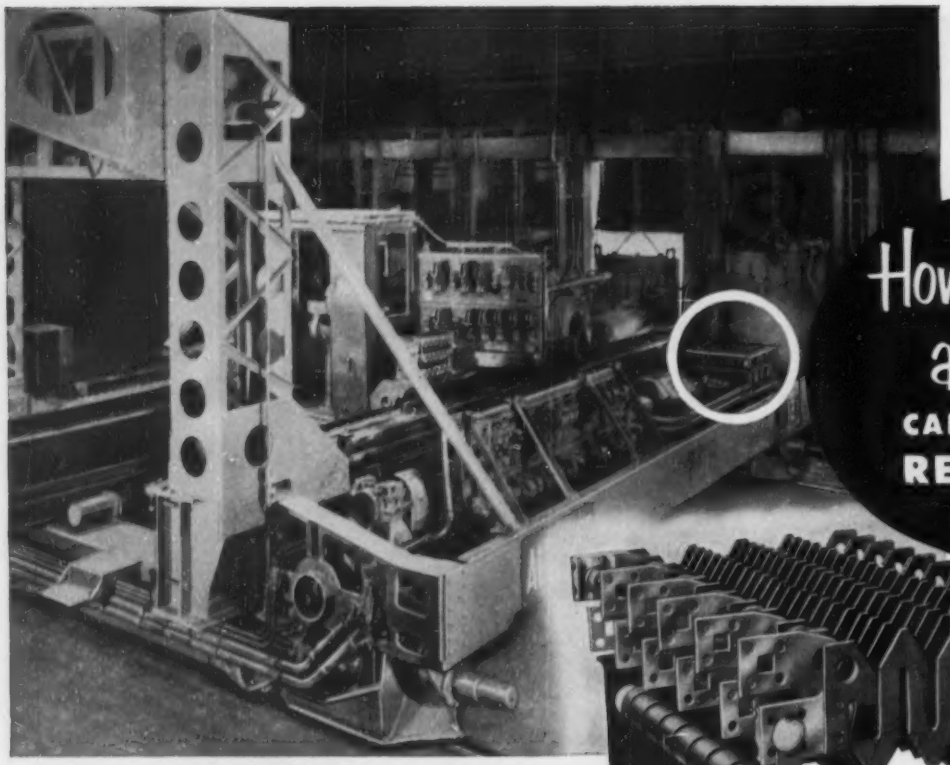
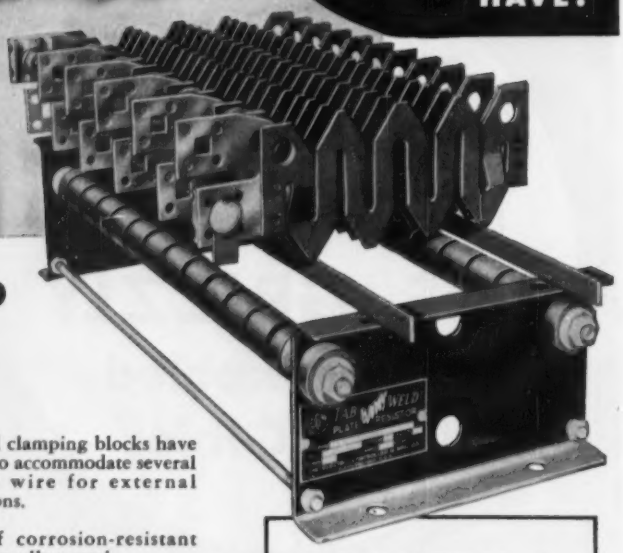


How many advantages CAN A RESISTOR HAVE!



ONLY EC&M TAB-WELD PLATE RESISTORS HAVE ALL THESE FEATURES!

1. Spot-welding of resistor ends, offset to bring adjacent grid eyes into intimate contact, results in permanent current-carrying path throughout the section.
2. No burning at grid eyes.
3. No periodic tightening of clamping nuts.
4. Terminal plates welded to resistor tabs along one side of section. Small adjustments in resistance value easily effected because plates are closely spaced.
5. No burning at taps.
6. Negligible resistance change between cold and maximum working temperature.
7. Insulating spacers of high dielectric strength accurately molded to shape from noncarbonizing material which remains dimensionally stable.
8. Terminal clamping blocks have grooves to accommodate several sizes of wire for external connections.
9. Made of corrosion-resistant chromium alloy steel.
10. Nonbreakable.
11. Double insulation to ground.
12. All standard sections same length, width and height.
13. Standard mill sections built with same size resistors per section.
14. Separate nuts on supporting rods clamp grid-stack independently of end-frame clamping. Accurate mounting-hole dimensions maintained regardless of variation of grid-stack length.

SHUTDOWN AVOIDED! Recently in one installation, a swinging overhead-crane load bumped resistors on charging machine and smashed end-frames and broke several spacers of grid assembly. *Shutdown was avoided* because current-carrying path of EC&M TAB-WELD Resistors remained intact and permitted charging of furnaces to continue. Later when down-time was available, section was replaced and returned to repair shop for new spacers and end-frames. This is another example of the durability of EC&M TAB-WELD Resistors.

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1808

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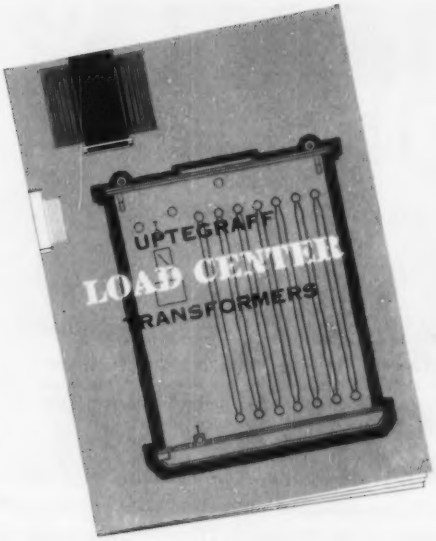


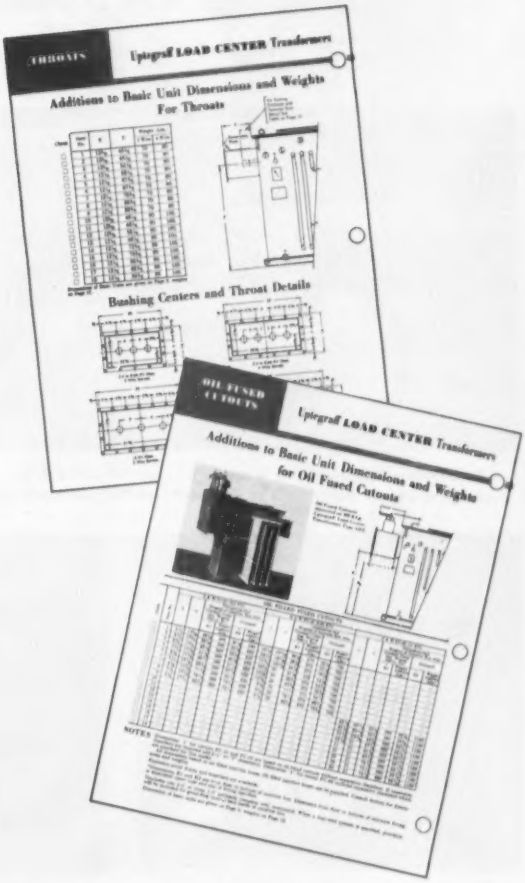
Uptegraff Announces a complete series of

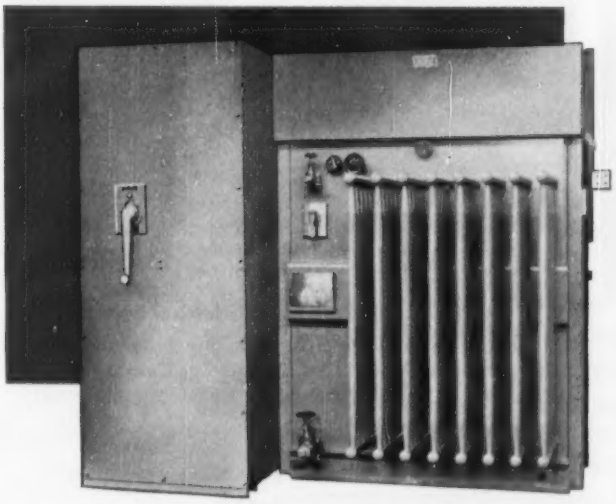
LOAD CENTER TRANSFORMERS

(150-2500 KVA)

Uptegraff announces a new series of *Liquid Filled* Load Center Transformers, made in eighteen ratings, from 150 to 2500 KVA., 3-phase. Designs are based upon extensive experience with this type of transformer, and represent modern engineering and manufacturing practice.

To simplify the selection and arrangement of auxiliary equipment, we have prepared a unique brochure, some pages of which are shown here. With this brochure, you can readily determine overall dimensions, total weights and other information for any combination of the Basic Transformer Unit with various types of switches and accessories. A check system permits the easy and accurate locating of desired data pertaining to various arrangements of properly rated equipment for any selected basic unit. We will be glad to send you a copy, free.


THROATS
Uptegraff LOAD CENTER Transformers
Additions to Basic Unit Dimensions and Weights For Throats
Bushing Centers and Throat Details
OIL-FUSED CUTOUTS
Uptegraff LOAD CENTER Transformers
Additions to Basic Unit Dimensions and Weights for Oil Fused Cutouts



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Scottdale, Pennsylvania

Send **for a free copy of this 20-page data book, giving important and useful information on Uptegraff Load Center Transformers. Fill out and mail the coupon below.**

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Scottdale, Pennsylvania

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EW-6

KEEPING UP WITH TOMORROW:

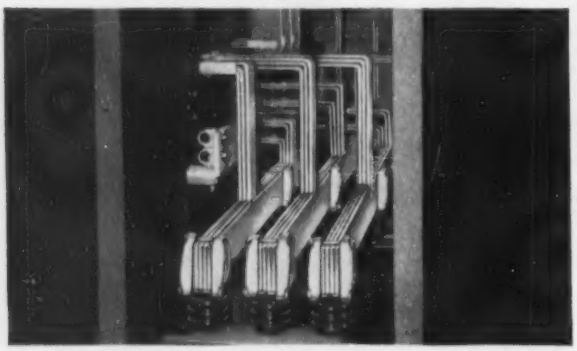
Depend on Reynolds Aluminum for All That's New in Electrical Applications. New Design, New Engineering, New Facilities to Produce

Young, Vigorous Thinking is the keynote of Reynolds competent staff. Unhampered by precedent, yet tempered by experience, these men offer *complete* aluminum design, engineering, construction and production service.

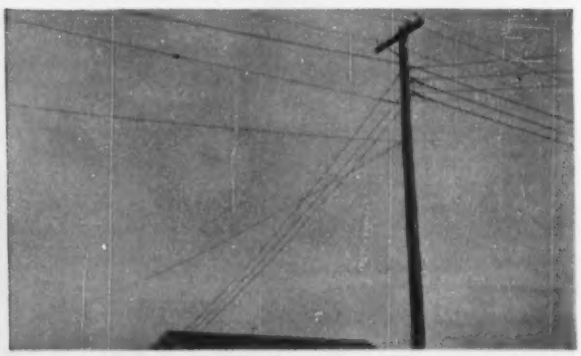
To Reynolds, each design, construction or production problem is a *new* problem—and the problems of no two customers are the same. Thus, you are assured of individual attention to your electrical aluminum needs. You are assured of products that meet or exceed your specifications. You are assured of a *complete* aluminum service by young vigorous men who think in terms of tomorrow's needs *today*. You are assured of the latest production facilities and methods to keep quality high, costs low.

In short, when you name Reynolds as your key supplier of ACSR, covered conductor, bus conductor or aluminum for any electrical application, you are assured of all that's *new!*

Expanding Facilities. This is a view of a section of the large, new cable stranding department at Reynolds Listerhill, Alabama plant.



Typical Aluminum Bus Conductor application in electrical control equipment. Costs *less* than conductor made of other metals; gives more conductivity per dollar; is strong yet lighter in weight.



Photograph above shows typical installation of covered aluminum conductor for both secondary lines and service drop.

"Reynolds Aluminum in the Electrical Industry"

Send for your copy of this new brochure—includes photos and information on Reynolds Covered Conductor, ACSR, Bus Conductor, Engineering Service, etc. Write to the address at left.

For full details or engineering assistance call your nearest Reynolds Branch Office or write Reynolds Metals Company, 2584 S. Third St., Louisville 1, Ky.

See "Mister Peepers", starring Wally Cox, Sunday nights on NBC-TV.

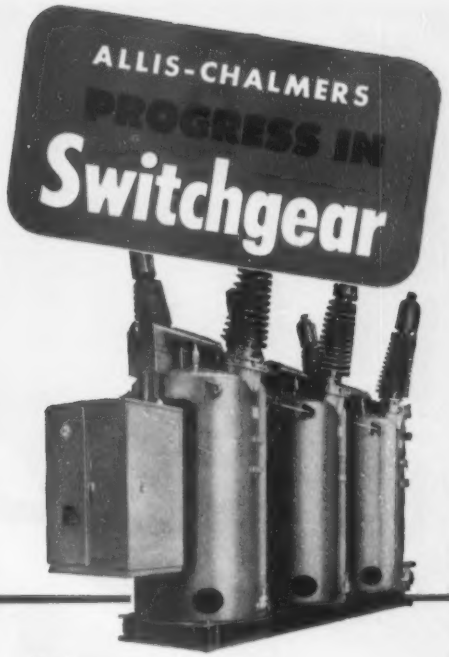
REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

RELIABILITY

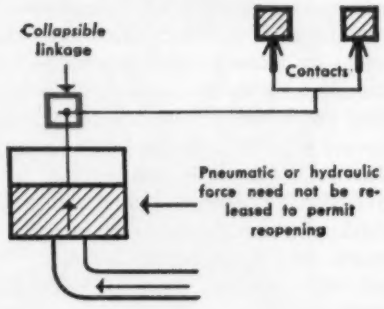
In Large Circuit Breaker Operation Depends Upon

THIS BASIC DIFFERENCE



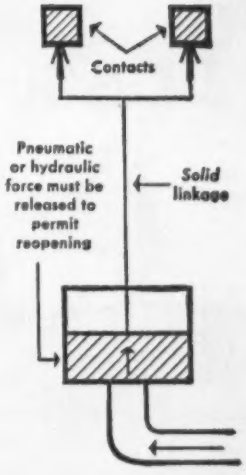
Allis-Chalmers *Mechanically Trip-Free* Mechanism

When opening after closing against a fault, the Allis-Chalmers operating mechanism does not require dumping of oil or air pressure. Trip coil simply releases a latch and the closing linkages collapse, allowing contacts to open at full speed. Operation is fully mechanically trip-free.



Other Operating Mechanisms

Air or oil pressure used to close contacts must be dumped — fast—to permit contacts to open. To do this takes a whole sequence of devices, including valves and solenoids. Everything must work perfectly. Otherwise breaker will be held closed or slowed in opening.



Opening the breaker when it closes against a fault, regardless of the position or condition of the closing mechanism, is the protective function of the breaker. To be fully protective under all circumstances, every one of your breakers should have a fully mechanically trip-free mechanism. For further details on what mechanically trip-free operation means to you, call your nearby Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4166

ALLIS-CHALMERS

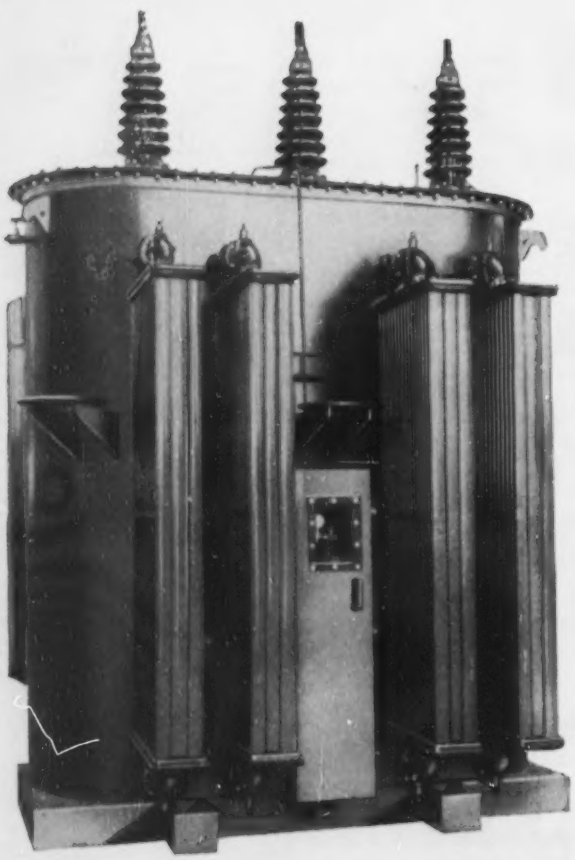
Power... at their fingertips...

Industries, commercial establishments, whole families all depend on reliable electric power as a motivating force for good production, effective lighting and essential home comforts.

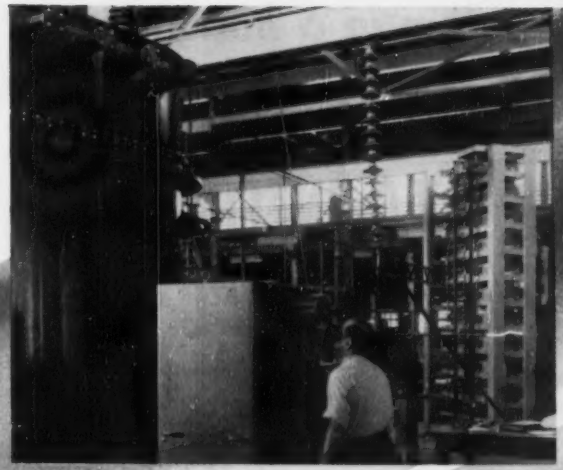
For 36 years Standard Transformer engineers, working with utility company engineers, have designed and manufactured better transformers for more efficient use and dependable channeling of electric power. Service records, dating years back, prove the dependability; the economy; the low maintenance cost of STANDARD Power Transformers.

STANDARD Power Transformers are embodied with compactness of design, inherent strength and exceptional stability. Manufactured with extreme care, STANDARD Power Transformers are built to your specifications. STANDARD engineers, working with your engineers, arrive at the best construction and design for your particular needs. Normal loads . . . and overloads can be handled again and again whenever emergencies arise.

There's a Standard Transformer representative near you. Call him. Have him help you with your power transformer installation.

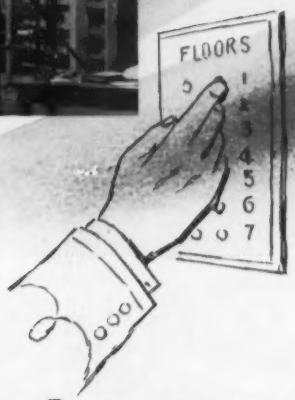


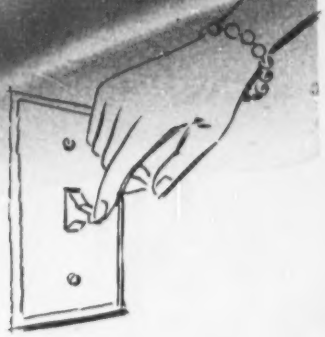
STANDARD Type AT, OISC Power Transformer, 7500 KVA, three-phase, 60-cycle, 66,000 to 13,800 volts, gas-seal construction, equipped with lightning arrester mountings and arranged for addition of forced air cooling.



TESTING

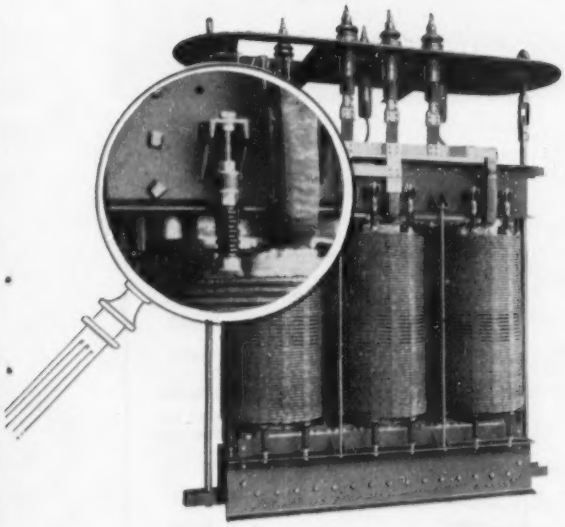
This view is impulse testing a large Power Transformer in STANDARD'S modern plant at Warren, Ohio. A surge generator, with a range of one million volts, is used for ASA and NEMA standard and front-of-wave-impulse tests. Each transformer, no matter what the size, is subjected to standard commercial tests—both during manufacture and at completion. Experienced, thorough testing and inspection assure you of the finest transformer performance.





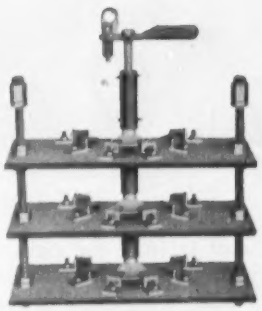
PUT THERE BY *Standard* POWER TRANSFORMERS

TRADE MARK



TAP CHANGER

STANDARD'S specially designed three-deck tap changer switch is externally operated without excitation. It also has positive contact with wiping action which has proven dependable for many years. Normal settings are with a 4-tap voltage selection . . 2½% taps within 10% range of normal rating. STANDARD supplies transformers with 4 taps above or below, or half above and half below as specified by the customer at no extra cost. Contact-making points are submerged in oil.



CORE AND COIL ASSEMBLY

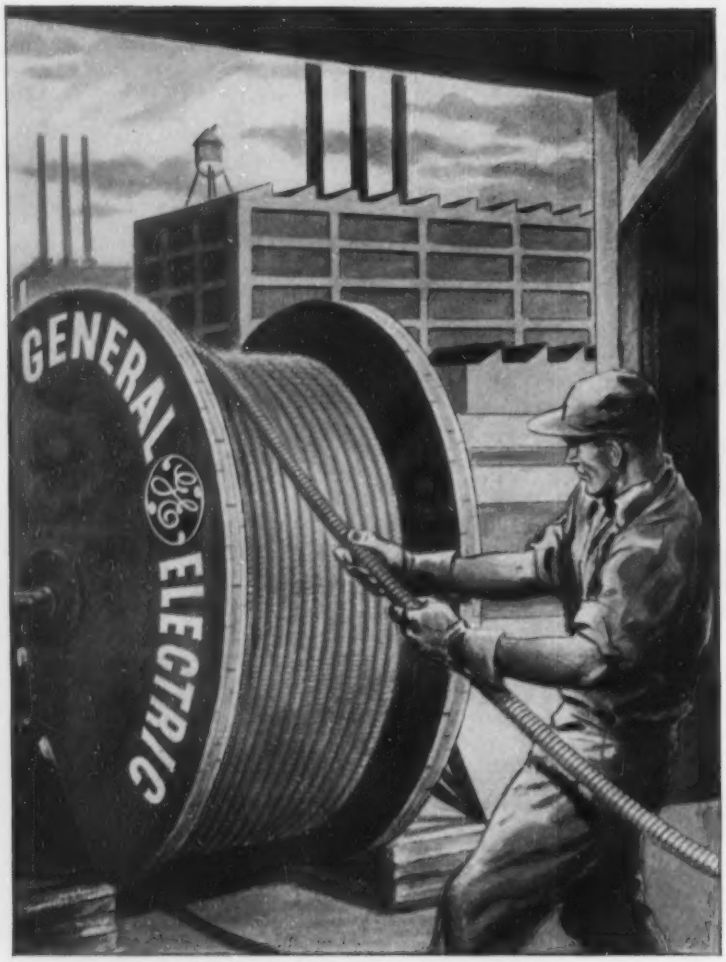
This view shows the low voltage side of the core and coil assembly of a Power Transformer. Note STANDARD'S special design spring bracing with compression-type porcelain insulators on high voltage coils to compensate for the movement of coils during short circuit. It also compensates for shrinkage of the coil in operation.

THE *Standard* TRANSFORMER COMPANY

WARREN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

When you need a cable system in a hurry—



G-E V-C INTERLOCKED ARMOR CABLE SYSTEM cuts both time and cost

Installation Time Reduced

If you're building or modernizing a plant, and production can't wait, use a General Electric V-c interlocked armor cable system for primary and secondary power distribution. It can be installed fast, indoors or outdoors, around corners, over beams, in long runs down the production lines. The cable is installed on low-cost aluminum racks hung from the ceiling, and spliced with simple mechanical joints. Engineering, as well as installation time, is cut; production can start much sooner than would otherwise be possible.

Wiring Costs Reduced

The cost table at the right will show you another good reason for using G-E armored cable. Installed costs of secondary feeders are 24% lower than those of the next most economical system. Add to this the future cost savings due to the adaptability of an armored cable system. Each circuit is a separate cable that can be moved or spliced easily when load requirements change.

For further information on this quickly and economically installed cable system, consult your G-E cable specialist, or write Section W114-627, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

COMPARISON OF MATERIAL COSTS
for plant distribution systems (Rated capacity 2000 amperes at 480 volts)

Carrier	Estimated cost per 100 feet
Varnished cambric interlocked armor cable system including racks*	$3000
Varnished cambric and braid in steel conduit	$3966
Type RH rubber insulation in steel conduit	$4660
Aerated bus-way	$4976

*Figures based on steel racks. Aluminum racks are normally used because they are lighter and easier to handle.

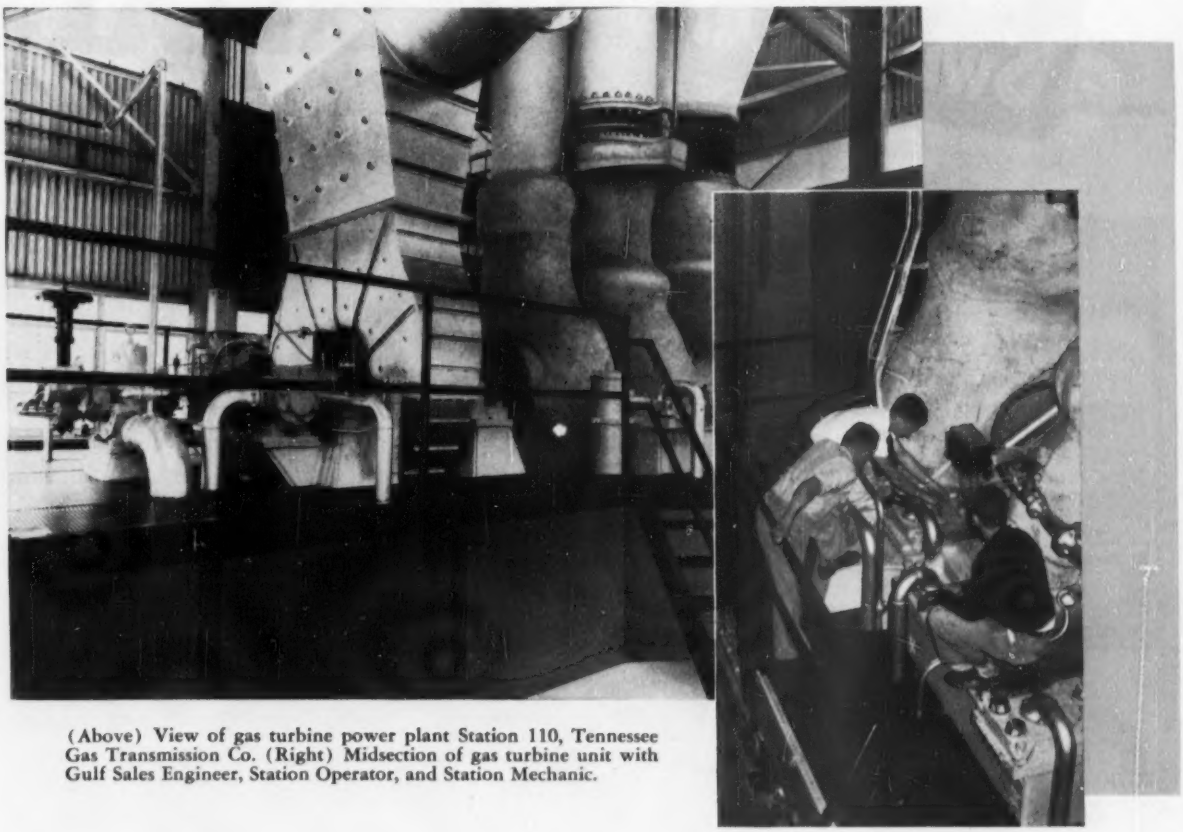
REWIRE AMERICA
WITH GENERAL ELECTRIC WIRING SYSTEMS

Progress is our most important product

GENERAL ELECTRIC

IT'S GULFCREST OIL

FOR **GAS** TURBINES, TOO—



(Above) View of gas turbine power plant Station 110, Tennessee Gas Transmission Co. (Right) Midsection of gas turbine unit with Gulf Sales Engineer, Station Operator, and Station Mechanic.

Shown above is a new type of gas turbine pumping unit in operation during the past year at the Morehead, Kentucky Station of Tennessee Gas Transmission Company.

To help protect its investment in this modern equipment, Tennessee Gas Transmission Company uses Gulfcrest Oil for the lubricating system. And this great oil is doing the fine job expected of it.

To hundreds of progressive utilities, the name Gulfcrest means outstanding quality and long life, as well as the sure protection so important to continuous, dependable operation. Super-refined by Gulf's exclusive Alchlor Process, Gulfcrest is the world's finest turbine oil!

Call in a Gulf Sales Engineer and ask him to recommend the proper grade of Gulfcrest for your turbines—gas or steam. Write, wire, or phone your nearest Gulf office.

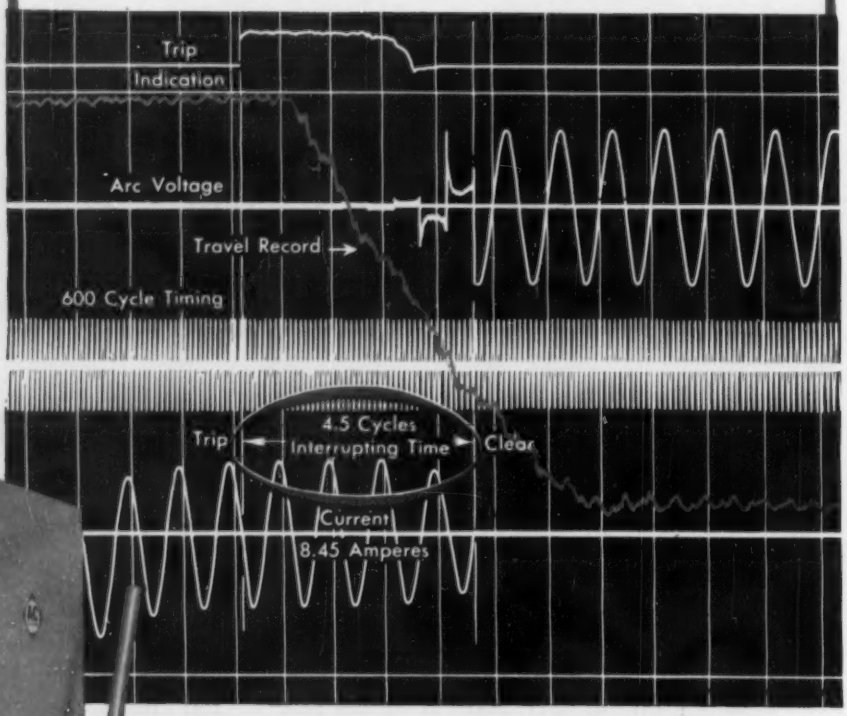
GULF INDUSTRIAL LUBRICATION

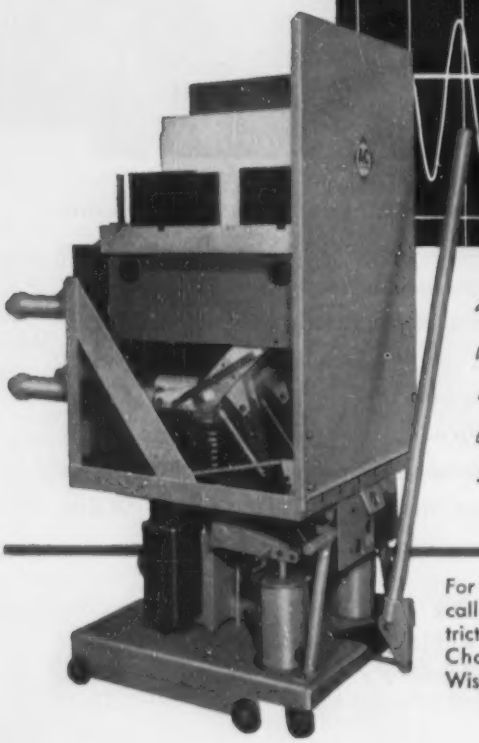
GULF OIL CORPORATION
GULF REFINING COMPANY
1822 Gulf Building
Pittsburgh 30, Pennsylvania

ALLIS-CHALMERS
PROGRESS IN
Switchgear

Here's ON NEW 13.8-kv METAL-

FAST ON LOW CURRENTS



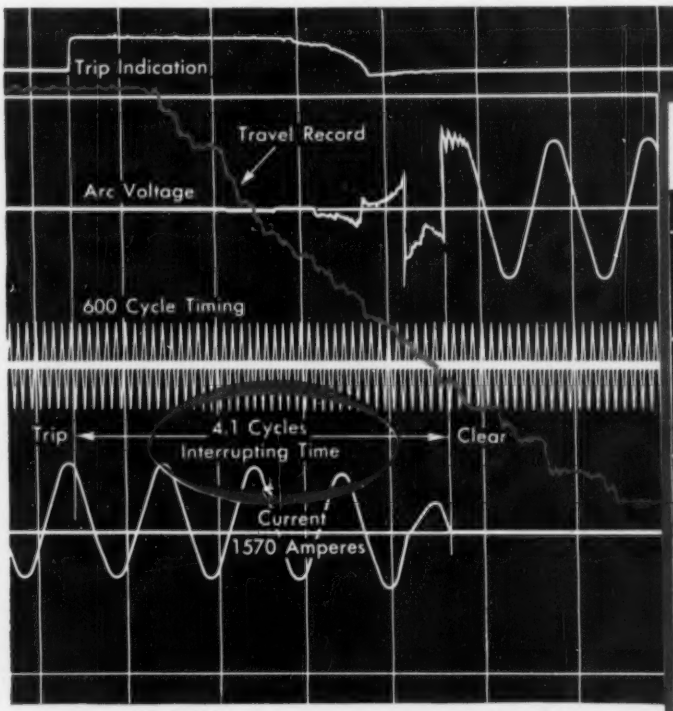


4.5 cycle and 4.1 cycle interruptions shown here are well within 8 cycles allowed by the ASA standards for even heavy currents. Low current switching··· always considered difficult··· now handled easily. Horizontal contact separation plus effective puffer design make this possible.

For additional information, call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4288

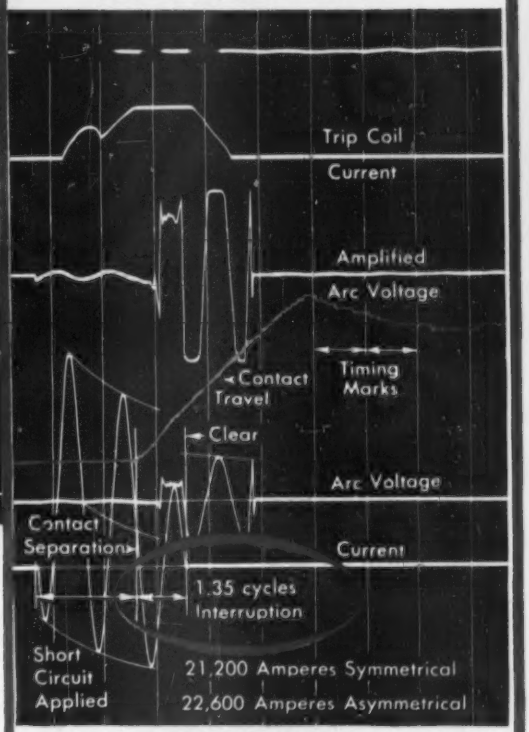
ALLIS-

Proof OF FAST INTERRUPTION
BREAKER for CLAD SWITCHGEAR



New breaker also has high speed 4-bar mechanism··· "blow-on" contacts ··· and sectionalized arc chute assembly that can be lifted off by one man.

FAST INTERRUPTION AT 500,000 KVA



AND FAST ON HIGH CURRENTS TOO!

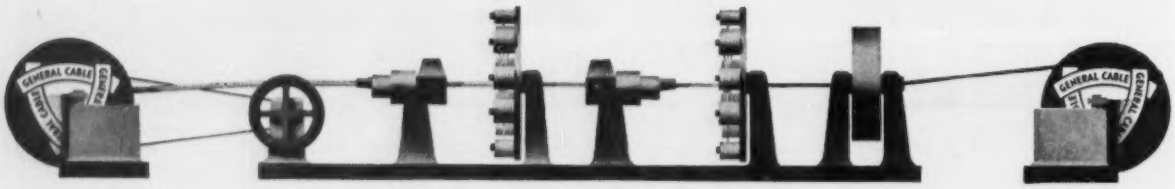
CHALMERS

A-C ALLIS CHALMERS

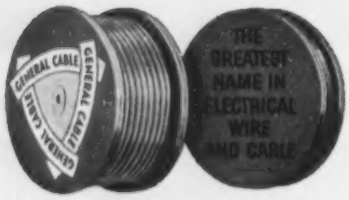
THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

BEAT THE HEAT

on electrical wires and cables at lower cost



With All-Asbestos and Asbestos-VC



BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

General Cable All-Asbestos and Asbestos-Varnished Cambric wires and cables provide safe, sure wiring for power, control, apparatus leads and switchboard installations. Especially where heat is a factor or when resistance to flame, oil, grease or corrosive fumes is a must.

Better than other types of insulation, All-Asbestos and Asbestos-Varnished Cambric wires and cables permit higher current carrying capacities with the same conductor sizes or the same current carrying capacities with smaller conductor sizes. These wire and cable products are ideal for installation near furnaces, ovens, boilers and in similar hot locations.

STANDARD CONSTRUCTIONS

	Insulation	Covering	Conductor
ALL-ASBESTOS	Asbestos	Asbestos braid, or without covering	Solid, stranded, flexible copper or aluminum
ASBESTOS-VC	Asbestos and Varnished Cambric Asbestos and Gencaseal (polyvinyl plastic)	Asbestos Braid Cotton Braid Lead Sheath	Solid, stranded, flexible copper or aluminum

Whatever your wire or cable problem—only General Cable makes and can supply every type you need. For future electrical needs—it pays to *wire bigger* when building new, *wire bigger* when re-wiring, too! See your courteous General Cable Representative today!

GENERAL CABLE CORPORATION

420 Lexington Ave., N. Y. 17, N. Y. • Sales Offices: Atlanta • Buffalo • Cambridge (Mass.) Chicago • Cleveland • Dallas • Detroit • Greensboro (N. C.) • Houston • Indianapolis Kansas City • Los Angeles • Memphis • Milwaukee • Minneapolis • New York • Newark (N. J.) • Philadelphia • Pittsburgh • Portland (Ore.) • Rome (N. Y.) • Rossmoyne (Ohio) (Cincinnati area) • St. Louis • San Francisco • Seattle • Syracuse • Tulsa • Washington, D. C.

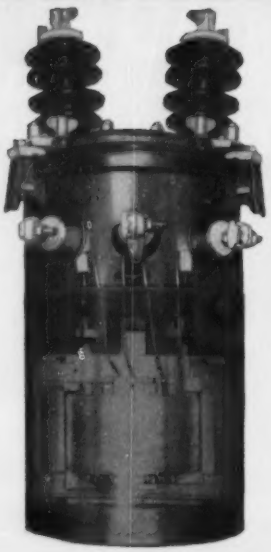
and this one...
DIED of SHOCK
HERE
EVERY Porcelain Products Suspension Insulator is Routine Tested FOUR TIMES as follows:
1 Every unassembled Porcelain Shell gets
(a) Full Three Second high frequency flashover
PLUS (b) Full Five Minute vigorous and continual 60 cycle flashover
2 Every assembled insulator gets
(a) Mechanical pull test to 50% of its rated mechanical strength
THEN (b) Full fifteen Second high frequency flashover prior to packing
These tests are greater than the minimum requirements of AIEE Standards No. 41 to assure you of long life—continuous service on your lines
TO GUARANTEE PERFORMANCE HERE
PP INC
Porcelain Products, Inc.
PARKERSBURG, WEST VIRGINIA

CHANGE TAPS ABOVE HOT OIL LEVEL

. . . with Moloney Positive Action Tap Changer

The Moloney HiperCore Tap Changer is unmatched in ruggedness. The tap changer is located inside the transformer tank with the operating handle *above* the hot oil level. Tap positions are numbered and plainly visible when handhole cover is removed. Double-wedged contacts snap into place with a wiping action. Tin plated chrome vanadium springs provide high pressure contact assuring low operating temperature.

MEDA-24



HIPERCORE TRANSFORMER PLUS FEATURES . . .

- Rolled Tank Bottom
- Reusable Retained Cover Gasket
- Non-rotatable Low Voltage Bushings
- Lower Hottest-Spot-Over-Oil Temperature
- Longer Operating Life
- Greater Short-Time Overload Capacity

MOLONEY ELECTRIC COMPANY

Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Constant Current Transformers • Step Voltage Regulators • Regulating Transformers • Unit Substations • Network Transformers • Capacitors • Transformers for Electronics

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

It's a Grass Roots Job

An industry conference group including EEI, NEMA, NECA, NAED, IAEL, and NARDA was organized last year. This group was set up for the purpose of promoting the co-ordination of industry sales activities, adequate wiring and other similar programs and to encourage local level support of industry activities.

The conference group has made progress in its stated purpose. But as yet not much is visible in the way of accomplishment. What has been done is mostly exploration of potentials and problems and preparation for attack on them. This work moves slowly, if only for the reason that the group is a national body whose meetings cannot, of necessity, be as frequent and always as completely representative as all concerned would like them to be.

But while little that is concrete and specific can yet be credited to the conference group, its few meetings have already done much in laying that firm foundation of mutual confidence and understanding between the various segments of the industry that is needed for attainment of the common goal.

How much easier it is for local groups, men who can, if they only will, meet almost every day, to lay the foundation of mutual confidence and understanding. How much of that has been done? How much more remains to be done?

We can't answer these questions. We can only hope that the condition today is better than it was two years or so ago. Then it was that Electrical World published a survey in which 249 power companies replied. Of these, 120 were members of local electrical leagues, 170 said they cooperated with dealers, and 165 reported cooperative advertising with the local trade. These figures show that only two out of three power companies—and that is far from enough; enough must be all—working with their natural allies in forwarding electrical living.

There are today some 65 electrical leagues in this country. There should be several hundred if everywhere in the nation dealers, distributors, contractors, and utilities are to join together in co-ordination of activities for profit to all.

There is a great virtue in a formal organization, such as a local league or association. It is a definite, specific thing to which one can belong and be a part of. It provides a strong point as a center of operations. Without such an established, recognized point, effort is likely to be disorganized and futile no matter how much any one interest tries to co-ordinate the whole.

Simply because it is the biggest among local electrical interests, the responsibility lies on the utility to bring all together in the common purpose. No national inter-industry conference group can do that job. It must be done on the home grounds. Co-ordination, like charity, must begin at home.

Trucks Are Tools and Utility Fleets Big Business

Behind the unequalled service which American power suppliers truthfully boast they provide their customers is an immense fleet of motor vehicles—trucks, tractors, trailers, and passenger cars. Industry stories seldom mention them. New power plants, long transmission lines, and multi-million-dollar expansion programs get the press releases. But just as important are the motor fleets that speed construction work, reduce costs, facilitate maintenance, and bring to the customers the friendly representative of the local power supplier.

Construction and maintenance of today's power systems would be impossible without the truck. This is no longer the wagon box propelled by motor of 40 years ago. Today trucks are tools. They dig holes; erect poles; raise transformers; pull in lines; pump water; and carry equipment, material, and men. There are trucks designed for maintaining street lights, trimming trees, and washing insulators. There is a truck for every job.

And behind these truck fleets and the more prosaic fleets of passenger cars which haul bosses, salesmen, and utility representatives is a corps of transportation directors. They see to it that the vehicles are always ready, used to the best advantage, and operated at the least cost. Today they are mighty important men, for utility motor fleets are big business.

A survey made by Electrical World indicates that power suppliers have 105,000 trucks and cars on the road. Each year they roll up a total mileage of 1,110 million miles. And keeping them rolling costs $80 million. At first glance this may seem trivial in the operations of a multi-billion-dollar industry. But $80 million a year soon adds up, especially since the fleets are growing and are expected to continue growing.

Yes utility motor fleets are big business. Because Electrical World is well aware of this, it has devoted ten pages of this issue to a survey of motor transportation. The hope is that it will lead the industry to give more thoughtful consideration to an important tool in its operations.

Utilities Must Guide Appliance Standards

Healthy operation of the electric utility industry requires that the industry exercise continuing leadership with regard to utilization equipment. This leadership at various times and under varying conditions in the past has taken the form of development, or assisting in the development, of utilization devices for the purpose of filling the needs of customers and building markets for such devices through sound sales and promotional programs.

Several recent occurrences have emphasized the need for utilities to reassert that leadership. For instance, problems connected with the mushrooming of room air conditioners require the guiding hand of the utilities because:

1. They have the best understanding of the overall economics involved.

2. They know that dissatisfied users, experiencing poor voltage, flickering lights, or unsatisfactory performance, will do much harm to the air conditioner market.

3. Customers do not know and cannot be expected to understand the economics of a single vs a 3-phase installation or a 120 vs a 240-v installation.

4. Customers have confidence in the guidance of their electric utility in such problems, and they have a right to expect that guidance.

5. If they are allowed to spend millions of dollars for equipment that does not come up to the high standard of performance they have come to expect from their electrical appliances, the result will be detrimental to the entire electrical industry and particularly to the utilities.

There have been other recent developments in the field of utilization devices that require the attention and guidance of the electric utilities. Pros and cons of requirements for standards of performance were discussed at the recent AIEE Appliance Technical Conference. Out of these discussions it became apparent that utilities will continue to have a heavy responsibility in seeing that appliances satisfy their buyers. At the same time the utilities should see to it that any standards set up really serve a practical purpose and do not just add to the purchase price.

Industrial Statesmanship Gets a Boost

The Southern Co and Middle South Utilities, Inc, are to be congratulated for the success to date of their plan to supply power for the Atomic Energy Commission project at Paducah, Ky. The two holding companies have agreed to build a 650,000-kw plant which will relieve the Tennessee Valley Authority of part of its commitments to the AEC . In turn this will make it unnecessary for TVA to build another steam plant at this time.

This action of the executives of the companies might well be called industrial statesmanship of the highest order, for the engineering, economic, and political problems in securing acceptance of such a proposal are unusually complicated (See page 88).

The Preference System—A Timely Talk

Though the preference system affects all Americans, few are aware of it. These few for the most part live close to areas where agencies getting subsidized energy under this system are selling it at a price below that which tax-paying electric companies must charge for energy generated at their own plants. To make other Americans aware of the inequities of the preference system, the National Association of Electric Companies has published a little booklet, "Some Timely Talk about the Preference System." It will do good only if the investor-owned companies will take the trouble to distribute it.

THE ELECTRICAL WEEK

The Issue's News Highlights . . . President's directive to AEC to negotiate with Dixon-Yates group for power instead of with TVA sets off a Congressional battle.

Congress kills authorization for federal development of Coosa River in Alabama, clearing way for Alabama Power Co to apply for license to build five-dam, 360,000-kw project there.

Conferees compromise on $457 million for Army civil functions, $8 million less than President asked.

A report that Tennessee's Gov Frank Clement plans a $200-million fund to build more steam plants in Tennessee Valley was checked with the governor who said it was "news to him." He stated he could not comment on a subject about which he has no information. Herbert Bingham, secretary of Tennessee Municipal League, one of Gov Clement's power policy advisers, said there was nothing to the report.

The rewiring financing plan of Cincinnati G&E for residential and commercial customers has shown an excellent acceptance since it was inaugurated on Nov. 1, 1953. A total of 458 jobs from 170 contractors for a total amount of $114,779 had been accepted up through June 18, 1954.

Duncan, Okla., citizens vote 2,454 to 1,201 to turn down proposal to sell its municipal system to Public Service Co of Oklahoma for $601,695.

Boards of Supervisors in Tate and De Soto Counties in Mississippi have scheduled an election for July 3 on a proposal to decide whether a new public power association should be formed. Mississippi P&L has filed protests against the move in Chancery Court.

Appalachian Electric Power Co is planning to buy electrical systems in Longacre, Carbondale, Harewood, Marting, Five Mile and Kingston, all in West Va.

Compromise has been reached in negotiations between City of Cleveland and Cleveland Electric Illuminating Co on latter's application for a rate increase. Instead of CEI getting $5.3 million more a year from that city's domestic, commercial, and industrial users it will get under the compromise, which must be ratified by City Council, $4.2 million. New rates will probably not go into effect until Feb. 1, 1955. Adoption of the negotiated recommendations by City Council June 28 is virtually assured.

Iowa Electric L&P has purchased the Northwestern L&P. Stockholders of both companies have approved the sale which will become effective on June 30 . . . Duke Power has received North Carolina PUC approval to sell its bus business in Salisbury, Spencer, and East Spencer, N. C., to Consolidated Bus Lines, Inc.

Off the Washington Wire . . . More of TVA's activities will be financed out of its operating income and less out of Congressional appropriations under Fiscal 1955 Appropriation Bill which Congress sent to the White House. Conference committee settled on $120 million for the year beginning July 1, compared with $103.5 million voted by the House and $129.5 million voted by the Senate. For fiscal 1954 TVA got $188.5 million. Committee in approving $12 million for transmission system facilities directed that this be financed out of corporate revenues, as the House voted, rather than by an appropriation as the Senate proposed. For resource-development programs, final bill calls for a total of $1 million to be spent, $600,000 of this to be financed out of corporate budget, and $400,000 by appropriation from the Treasury.

New booklet, "Electric Current Abroad," showing the kind of current being used in principal cities of almost 200 countries, has been put out by the Bureau of Foreign Commerce. Copies can be obtained from Superintendent of Documents, Washington 25 at 20¢ a copy.

Westcoast Transmission Co will appeal to Third Circuit Court of Appeals in Philadelphia a FPC ruling which granted Pacific Northwest Pipeline Corp the right to pipe gas from natural gas fields in New Mexico to Washington and Oregon. Westcoast company had planned to supply Pacific Northwest with Peace River gas from Canada. Pacific Petroleums, Ltd, Pres George L. McMahon, sponsor of Westcoast, said FPC ruling "does not alter the fact that Peace River gas is 500 miles closer to the market in Washington and Oregon than New Mexico gas."

Okonite Co will ship its first American-built 230-kv, high pressure, pipe-type cable to Sao Paulo L&P, Brazil, in July (see page 137).

AIEE elected A. C. Monteith, vice president, Westinghouse Electric, as new president at its Summer and Pacific General Meeting in Los Angeles.

Executive Changes . . . Edward M. Naughton, vice president and general manager, was named president of Utah P&L to succeed George M. Gadsby, who continues as chairman. Joseph E. Cushman and David D. Moffat, Jr, were made vice presidents. Appointments are effective July 1 . . . George A. Peers, manager of electric operations for Pacific G&E, will succeed George H. Hagar as vice president in charge of electric operations June 30 when Hagar retires.

Obituary . . . Dr Karl T. Compton, leading figure in development of atomic bomb, died June 22 in New York. The 66-year-old scientist, a director of McGraw-Hill Publishing Co, was chairman of corporation of Massachusetts Institute of Technology.

YES

says Nichols

AEC general manager announced President's private power directive at Joint Committee hearing, wants to negotiate with Dixon-Yates

NO

says Murray

AEC commissioner, who spoke for majority, disagreed with President. Agency, he said, should not contract for power above its own needs

TVA Load Shift: President Directs, Commission

When President Eisenhower ordered Atomic Energy Commission to shift 600,000 kw from government to privately owned utilities he set off a public power-private power battle that promises to be a rouser.

The order directed AEC to "proceed with negotiations" for purchase of the power from a joint concern formed by Middle South Utilities, Inc, and The Southern Co. Power to be supplied in this manner would come from a proposed 650,000-kw, $107,250,000 steam plant the privately owned utilities would build at West Memphis, Ark. It would be fed into Tennessee Valley Authority at Memphis, Tenn., to replace power TVA would supply AEC at Paducah, Ky.

The order was questioned almost immediately by the General Accounting Office. In a letter to Chet Holifield (D.-Calif.), Frank H. Weitzel, acting Controller General, suggested calling for bids on construction of the power plant, with the contract going to the lowest bidder. Holifield read the letter before the Joint Congressional Committee on Atomic Energy, of which he is a member. The order itself had sparked a heated debate at the committee hearings, called to consider revision of the Atomic Energy Act. There were indications that opponents of the proposal might move to delay or prohibit negotiations on such a contract.

Dixon-Yates Plan . . . The private enterprise proposal, which President Eisenhower favors, was put forward by Edgar H. Dixon, president of Middle South, and E. A. Yates, chairman of the board of The Southern Co. It is designated in official papers as the Dixon-Yates proposal.

If negotiations are concluded along the lines indicated by the Presidential directive, TVA stands to lose its plea for a 450,000-kw plant at Fulton, Tenn., which it would use to carry out its commitments to AEC and others.

While the main issue was drawn on public-vs-private power lines, the hearings produced a number of side issues that appeared nearly as important:

- Will Congress endorse this order which gives substance to a fundamental tenet of Republican power policy? That tenet is to let private enterprise serve the nation's power needs wherever it can on a reasonable basis. In this case it would conflict directly with TVA's plea for expanded generation facilities.
- Will the order interfere with the progress of legislation now pending before the Joint Committee to permit industrial development of atomic power? By merely raising the issue the progress of the atomic power legislation was retarded by several precious days as Congress moved toward what it hopes will be the last month of the present session.
- Does the President have legal authority to override the recommendations of AEC and technical experts of TVA in ordering the negotiations to proceed? Testimony at the hearings brought out that a majority of the five-man AEC was opposed to the private contract on the theory that AEC already had made firm commitments with TVA for delivery of this block of power. TVA technical experts also testified against the private proposal.

The Dixon-Yates proposal came as a result of an Administration effort to shift some 600,000 kw of AEC's power load from TVA to outside sources. In doing this, TVA would be at least temporarily relieved of having to build additional generation facilities to serve AEC and other loads in its service area.

Under the Dixon-Yates proposal, TVA would in fact continue to serve AEC's Paducah gaseous diffusion plant the full amount of TVA's commitment. But to replace that block of power in the TVA system, Dixon-Yates would build a plant across the river from Memphis, Tenn., and deliver power to that load area where TVA needs power most. This would relieve TVA from constructing its often-disputed Fulton Plant north of Memphis.

Private Power Costs Higher . . . While the cost of power from the Dixon-

Objects

Yates plant would be slightly higher than from a TVA plant at Fulton (AEC staff estimate: 3.67 mills vs 3.25 mills), private power spokesmen say more than 70% of the difference would be accounted for by taxes and cost of money which the private concern would be required to pay.

Under terms of the proposal, AEC would enter a 25-year contract with Dixon-Yates to furnish 600,000 kw of firm power to TVA at Memphis. TVA would take this power and credit it against the power it would deliver to AEC at Paducah. AEC would pick up the full tax bill for the private enterprise output, TVA would presumably pay a part of the difference between the cost of power from the Dixon-Yates Plant and its rate for power delivered to AEC at Paducah.

TVA supporters in Congress immediately attacked the Presidential order as a means of undermining further expansion of TVA generation facilities. TVA Power Manager G. O. Wessenauer offered estimates indicating his agency could supply the power much cheaper from its own facilities.

However, the Administration rejected this argument in a letter presented at the Joint Committee hearings. Said Budget Director Rowland Hughes:

"While reported cost is necessarily an important factor, it cannot be the deciding factor in comparing the operations of a federal agency with a private organization. There are many activities now performed by private enterprise for the federal government which the government, because of its freedom from taxes and its enormous credit resources, could seem to perform more cheaply under a concept that non-payment of taxes by the federal government is a true saving in cost. This concept ignores the consideration that when a commercial-type operation does not pay taxes, it leaves a larger amount of taxes to be absorbed by other taxpayers.

"If this concept were accepted and it were also considered sound to provide funds through government borrowing, the government might propose to take over these activities on the grounds that they would cost less under government operation. Such action would be contrary to our basic conception of a private enterprise economy and to the policies of this Administration."

Leads Opposition . . . Representative Holifield led the opposition to the Presidential order. His questions either brought out or emphasized the AEC split over the power purchase proposal, conflicting AEC-TVA technical data and cost comparisons of the two proposals.

Two other Democratic committee members, Rep Melvin Price of Illinois and Sen John O. Pastore of Rhode Island, sided with Holified, but let him do most of the questioning. Tennessee Sen Albert Gore, also a Democrat, participated on the TVA side although he is not a member of the Joint Committee.

Other members of the 15-man committee voiced no public opposition to the Presidential power directive—leaving the Holifield-Price-Pastore team as a small but vocal minority.

As of early last week, the Joint Committee had made no move to bar the Dixon-Yates proposal despite the Democratic opposition.

At one point during the hearings, Gore charged the AEC invitation for a power supply proposal was "tailor-made" for the Dixon-Yates group and no other group could have offered a successful bid.

It was AEC General Manager Kenneth D. Nichols who announced the decision to accept the Dixon-Yates proposal. He said he considered the decision a "Presidential directive" and would proceed immediately to begin negotiations. He presented the technical aspects of the decision, but said the policy came from higher sources.

Murray Dissents . . . Majority stand of the five-man commission was

BUT . . . says Holifield

Is it Legal? Joint Committee member urged SEC determine whether public interest was "adequately protected" by proposed contract with private power group

dramatized by Commissioner Thomas E. Murray who cast the deciding vote during the course of the committee hearings. In one of the hearing highlights, he told the committee, "I don't believe we should get into this business . . . I have never felt personally that AEC was an agency to contract for power over and above its own needs."

Murray's stand came somewhat as a surprise since he had been a key figure in urging AEC to negotiate previous large power supply contracts with private concerns.

Two other commissioners—Henry D. Smyth and Eugene Zuckert—also opposed AEC involvement in the Dixon-Yates proposal charging it would put AEC in the role of a broker for TVA power needs.

The proposal, however, won the endorsement of AEC Chairman Lewis L. Strauss and Commissioner Joseph Campbell—the only two Eisenhower appointees on the present commission.

AEC lawyers said the agency had sufficient legal authority to negotiate the proposed Dixon-Yates contract, a view adopted by Nichols in his presentation. The dissenting commissioners—Murray, Zuckert, and Smyth—based their opposition on policy rather than legal grounds.

Suggests Limiting AEC . . . During the course of the hearing, Representative Holifield suggested Congress may want to limit AEC authority to prevent negotiation of the type of contract proposed by Dixon and Yates. Legislation now pending on revision of the entire Atomic Energy Act incorporates the same provisions as are in the present law.

A fight on the floor of the House and Senate to limit this authority might possibly bring a full-fledged public-vs-private power debate on the atomic power legislation. If such a fight looms, legislation will not be brought to a vote at this session of Congress.

Little attention was given another proposal for supplying the block or power sought. That came from a syndicate headed by Walter Von Tresckow, a consulting business economist of New York.

Bureau of the Budget turned down the Von Tresckow proposal, saying many elements were indefinite, there was no organization to carry it out, and it offered no savings over the Dixon-Yates plan.

Allot Army Corps $457 Million

Congressional conferees' total for Engineers' '55 fund is $26 million above House and $27 million below Senate figures

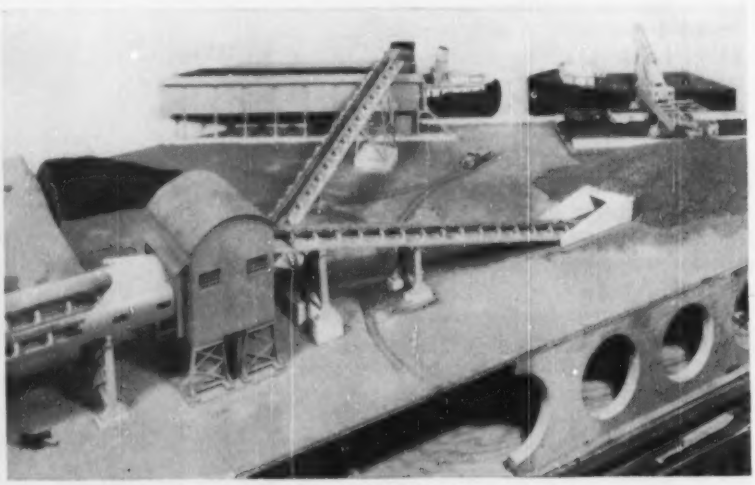
Congressional conferees last week split the difference between House-Senate versions of the Army civil functions appropriation bill for fiscal 1955. The compromise total was $457 million, $26 million above the House figure and $27 million below the Senate, as well as $8 million less than the President's budget message request.

$300 Million Construction Fund . . . On construction funds for Army Corps of Engineers projects, the conference committee came up with a figure of $300 million, which is likewise $8 million less than the amount Eisenhower requested and almost exactly half way between the amounts approved by the House and the Senate. Included in the construction sum is $2,603,000 for planning of projects, $400,000 higher than the House figure but nearly $700,000 below the Senate. For the important item of general investigations, the conferees compromised on $2,907,500, about $500,000 above House figure, $550,000 below the Senate's.

Dropped by the conferees was a $500,000 Senate item to start construction of Hartwell reservoir and power project—$90.6 million development on the Savannah River in Georgia and South Carolina. For the 17 other multipurpose projects, the committee agreed on compromise figure of $209 million.

Boost 'Dallas' Appropriation . . . House conferees agreed to $2.5 million of the $3 million that the Senate had put in the bill for Table Rock Dam in Missouri. They also allowed $36 million for The Dalles lock and dam—an increase above the original House figure permitted by an additional authorization Congress voted.

Here are the final figures in millions for other projects: Folsom Dam, Calif., $14.5; Buford Dam, Ga. and S. C., $9.3; Garrison Reservoir, N. D., $25; Oake Reservoir, S. D., $9; Old Hickory lock and dam, Tenn., $13.75; Chief Joseph Dam, Wash., $27.



New Method of Hauling Coal?

Working model of Riverlake Belt Conveyor Lines system for hauling coal and iron ore was unveiled this month at a press party and is being exhibited this summer and fall around Ohio. The belt conveyor, which would cost between $200 and $300 million to build, would transport coal and iron ore between Lake Erie and the Ohio River. Backers claim the project would mean substantial savings in coal and iron ore costs.

GOP Switch on Coosa—Local Boys Make Good

Congress officially endorsed a basic tenet of Republican power policy in clearing legislation to permit private power development of the Coosa River in Alabama.

That tenet is to give local interests—public or private—every encouragement to develop water power resources. It was succinctly put in the Administration's power policy statement of last August.

The bill now awaiting the signature of President Eisenhower suspends existing authorization for federal development of the Coosa—thus clearing the way for Alabama Power Co to seek a license for the five-dam, 360,000-kw hydroelectric project.

The measure sailed through both the House and Senate without a dissenting vote after receiving active support from all but one member of the Alabama Congressional delegation. It represents the first clear-cut Congressional approval of this portion of Administration policy.

What makes it more novel is that it gives this GOP power policy its first tryout in an almost solidly Democratic state on the fringe of the federally financed Tennessee Valley Authority. Furthermore the move has the strong backing of such lawmakers as Alabama Senators Lister Hill and John Sparkman and Rep Albert Rains, all of whom are enthusiastic TVA supporters.

Not a single witness appeared in opposition to the bill during hearings before the House Public Works Committee. The statewide organization of rural electric cooperatives withdrew its earlier opposition to the Alabama Power Co. proposal. The Senate Public Works Committee approved the bill without a hearing.

Why the Unanimity?

Senator Hill, who spoke for the bill in the Senate, had this explanation for wide support in his state for bill:

". . . in the Rivers and Harbors Bill of March 2, 1945, there was an authorization for the (federal) development of the Coosa River, and also a specific authorization for the construction of a dam known as the Howell Mill Shoals Dam.

"Since 1945, despite repeated efforts to do so, it has not been possible to have (federal) funds appropriated for the construction of that dam. Not one dollar has gone into the construction of the dam. The people of Alabama are very much interested in having the development go forward . . ."

Petitions from more than a hundred civic, farm, and veterans organizations and a number of local government councils support Hill's explanation. Signers of these petitions made it clear they believed Alabama Power Co could most effectively and quickly develop the stream for power, flood control and other uses benefiting the state.

With this kind of backing from the home folks, the Alabama Congressional delegation swung behind the move. All the state's House members introduced identical bills with the exception of Rep Robert E. Jones, Jr, a member of the House Public Works Committee which handled the bill.

That they gave their active support to the measure is evidenced by the fact that it went through both houses of Congress without a single objection recorded. A single member of the Alabama delegation if he had chosen could have forced extensive debate and delay of the measure by objecting to it on the House or Senate floor.

Legislation now clears the way for Alabama Power to receive a preliminary permit from Federal Power Commission for the five-dam project.

Application for the permit was filed last November, and has been pending awaiting outcome of the legislation.

Five Dams to Be Built

The five dams outlined in the application would be located along the Coosa in northeast Alabama (see map).

The proposed new development will cover a 225-mile stretch of the river from its confluence with the Tallapoosa all the way upstream to the Georgia line. The five new dams will have an initial installed capacity of 239,500 kw. Estimated average annual output of the five plants will be 1,155 million kwhr with this capacity.

Power generated at the proposed plants will be fed into Alabama Power system serving that portion of state.

Besides the power production, the dams will offer a measure of flood control, and will make navigation possible on the Coosa when necessary locks are provided by the government.

In suspending authorization, Congress directed FPC to write specific requirements in any license issued for project.

The legislation requries that the flood control features of the dams shall provide about the same amount of flood storage as would be provided by a federal development.

The company is required to file an application for an FPC license within two years of the enactment of the legislation. At least one dam must be commenced within one year subsequent to the issuance of a license and must be complete within five years from the issuance of a license. Remaining dams must be completed within ten years of the start of construction on the first dam.

If these schedules are not adhered to, the suspension of federal authorization is voided, and the federal government may acquire any plants or portions of plants constructed.

The company is also required to make provision for future installation of locks by the government.

New Study on Cleveland Units

. . . is expected to be authorized by City Council to determine cause of vibration in generators supplied by Brown Boveri

Legislation has been introduced in Cleveland's City Council at the request of the city's power and light division to help settle once and for all the trouble emanating from installation of two 25,000 kw Brown-Boveri Corp turbogenerators last year in the Municipal Lake Rd. power plant.

The legislation calls for an appropriation of $4,500 to hire a "disinterested" company of consulting engineers to decide whether the periodic vibration of the generators has been caused by one of two factors: (1) settlement of the building foundation; or (2) settlement of the steel substructures of the turbines themselves. The bill is expected to pass City Council early next month, according to Cleveland Commissioner of Power and Light Vincent DeMelto, and selection of the consulting company who will do the work will take place then.

Generators Running Smoothly . . . At the present time, DeMelto says, both of the generators in question are on the line and running smoothly at any operating capacity required within the machines' 3,000-25,000-kw range. But vibration has occurred several times since the machines were installed, and the city wants the problem solved before it finally "accepts" them from the manufacturer.

Final city acceptance of the equipment (the point at which the city assumes full responsibility for all operating problems) has not yet been reached. The performance bond will not be returned, DeMelto states, until the reason for the vibration has been decided and rectified. All expenses thus far on the machines have been paid by Brown-Boveri, and they will be responsible for future expenses until the city accepts them finally.

DeMelto does not believe there is anything basically wrong with these machines, that the problem is an operating one.

Two Studies Made . . . At the time of the first vibration, which occurred in No. 10 last December, the city asked a firm of engineering consultants, Burns & McDonnell of Kansas City, Mo., to find out what caused the vibration. Burns & McDonnell designed the foundation of the plant and supervised installation of the machines. These engineers found that the sub-structure of the turbines was at fault. Brown-Boveri engineers also came and made settlement studies, but found the building foundation at fault. The city decided to hold its decision in abeyance until it could ascertain whether the vibration would occur again. It has, and now the city will make its final decision on the basis of the findings of an as yet unnamed outside group of engineers.

Nice Kitty, Says Betty Lou; He's Not a Polecat

Dog chased Betty Lou Finn's cat Booboo up a pole in San Diego. Booboo, lovable but stupid, stayed up the pole two days. Hadn't the foggiest notion how he got there —just remembered something about being chased by a dog, mighty fast, mighty angry. Sat there, crossing and uncrossing his eyes while Betty Lou called, "Booboo, come down." Passing lineman finally rescued him. Booboo, above, didn't care much one way or another. But Betty Lou was happy.

Opening Throttle for Meramec's 2nd Unit

President of St. Louis' Chamber of Commerce, Aloys P. Kaufman, is assisted by Union Electric Co Pres J. W. McAfee as he opens the throttle of the recently completed second unit turbine at the company's Meramec Plant.

Pictured with them at dedication of the plant's second section are four Union Electric vice presidents (left to right): E. L. Hough, Dudley Sanford, (McAfee and Kaufmann), G. P. Gamble, and R. E. Moody. New unit has a capability of 140,000 kw.

CL&P's Norwalk Project Slated to Operate by '60

Connecticut Light & Power Co has announced that construction on the $20-million steam generating plant on Manresa Island off Norfolk, Conn., is expected to get under way within two years with operation slated for 1960.

Sherman Knapp, president of Connecticut L&P, said that enlargements being effected at the utility's Devon plant will meet the company's power needs for the next five or six years.

Permission to construct the plant was granted by the Norwalk Zoning Commission last January after months of controversy involving shoreline residents. Manresa Island is in a residential zone. Permission to build was granted under a special state statute giving zoning commissions the right to regulate the locations of power utilities. The State Supreme Court of Errors in a three to two decision last February upheld the constitutionality of the law (EW, Feb. 22, p 89).

Connecticut L&P's director of public relations, Paul V. Hayden, said a postponement of the active phase of the project was made possible shortly after public hearings in Norwalk when the government granted unconditional clearance for development of a power project at Shepaug in the Sandy Hook area.

The utility has acquired more than 80 acres of land on Manresa and in that area for about $800,000.

Publication of REA's Co-op Magazine Resumed

Rural Electrification Administration this month resumes publication of a magazine for the management of its co-op borrowers.

Titled "Rural Lines," it replaces the old "REA News" which was suspended in May of last year. Like its predecessor, the new publication is mainly a clearing house for REA information and news relating to the activities of REA borrowers and their associations.

In his message to readers, REA Administrator Ancher Nelsen said, "We hope to be able to report on the good things that you and your association or company are doing as a means of helping somebody else do a better job. This is bound to be a help in protecting the fine loan repayment record that has been set up to date."

New Type Reactor

Brookhaven scientists reveal 'liquid metal fuel' furnace at nuclear congress at Ann Arbor

Brand new entry in the race for an economical atomic power plant was announced last week by scientists from Atomic Energy Commission's Brookhaven National Laboratory.

The new type reactor—still in the preliminary design stage—would use a liquid metal alloy of uranium and bismuth as the fuel stream. This stream would be carried through the reactor core where the chain reaction would take place, then carry the heat produced to an outside heat exchanger. Provision would also be made to dispose of byproduct materials produced by the chain reaction.

Since graphite would be used as the moderator in this "liquid metal fuel reactor" (LMFR), it would not be a homogeneous reactor, although it would have some of the desirable characteristics of that type of reactor.

International Gathering . . . Announcement of this reactor was made in a series of papers presented by the Brookhaven researchers at the International Congress on Nuclear Engineering at Ann Arbor, Mich.

The LMFR, the Brookhaven men asserted, "may possibly be competitive with coal and oil fueled plants in most areas of the United States." In addition to its other characteristics, the LMFR also offers the possibility of breeding its own fuel through use of a thorium blanket surrounding the core of the reactor.

The LMFR announcement was one of the highlights of the week-long meeting of nuclear scientists, engineers, and government officials from some 20 nations this side of the Iron Curtain.

Index Is Available

Electrical World's semi-annual index for January-June 1954 has been prepared, and copies are now available upon request. They may be obtained without charge. Address requests to Electrical World, Editorial Office, 330 W. 42nd St., New York 36, N. Y.

11¢ a Mile Keeps

Nationwide survey of 57 utilities shows average vehicle operating costs range from 8 to 20¢ a mile. Combined fleets for systems studied totalled 9,500 cars and 17,500 trucks

When a utility spends a dollar on automotive operations, about 66¢ of it goes toward three items: gas and oil, repairs, and depreciation, each of which costs about 22¢

Electric Utility Fleets on The Road

Keeping electric utility fleets on the road costs approximately 11¢ a mile per vehicle. That's an over-all average of the sums spent by the 57 systems that cooperated in Electrical World's survey. Figured in that amount is a complete breakdown of all the costs that go into maintaining a typical fleet of cars and trucks—everything from gas and oil on down to depreciation expense and overhead.

Examining costs of operation for each type of vehicle independently, revealed definite patterns. As might be expected, the average cost per mile increased with the weight of the vehicle. The average for passenger cars came to 7.3¢ a mile, with a range from a low of 4.4¢ to a high of 12.2¢. Light trucks, including commercial cars, averaged 9.6¢ with one company reporting a low of 5.5¢ and another a high of 15.8¢. Medium trucks ran about 18.9¢ with a low at 12.3¢ and a high at 32.7¢ per mile, and heavy trucks averaged 32.1¢ ranging from 15.8¢ to as much as 66.8¢ a mile.

Over two-thirds of the total cost of operation stems from three items, each of which represents about 22% of the total: gas and oil, repairs, and depreciation allowance. Next are overhead costs, 10.2%, and servicing, 9.8%. Remaining items, in decreasing order, are expenditures for tires and tubes, 6.2%, other direct and allocated expenses such as antifreeze, 4.6%, and accident cost, 0.8%.

Fortunately the vehicles that cost the most to operate do not see heaviest duty in terms of average annual mileage. As a matter of fact, just as costs increase with the weight of the vehicle, average annual mileage decreases.

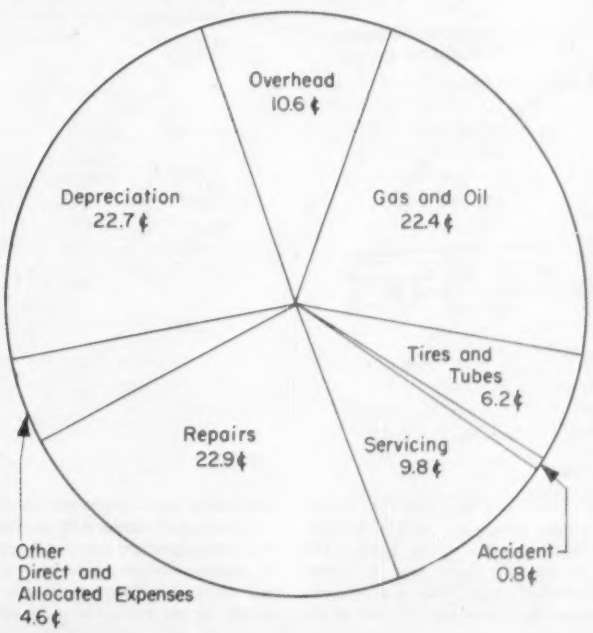
Most companies' annual mileages fell close to the given figures. One extreme case was a utility operating in a major city that experienced a low average annual mileage in every class of vehicle. Some of the smaller utilities showed up at the other extreme. A few had annual mileage of over 25,000 miles for passenger cars, reflecting wider area served with proportionately fewer vehicles.

On the basis of these average mileages and costs, over 44% of the total dollars spent by the utilities was used to maintain the passenger car fleet.

Average Annual Mileage

Passenger cars	13,311
Light trucks	10,539
Medium trucks	7,254
Heavy trucks	6,037
Total trucks	8,954
Total cars and trucks	10,571

Where the Automotive Dollar Goes . . .



Replacement and Addition Policy

	% Replaced Each Year	Average Life (Years)	% Added Each Year
Passenger cars	13.02%	7.7	4.51%
Light trucks	10.18	9.8	4.63
Medium trucks	6.38	15.7	3.84
Heavy trucks	8.71	11.5	6.89
Total trucks	8.74	11.4	4.63
Total cars and trucks	10.15	9.9	4.54

In the light of the fact that passenger cars only represented about 35% of the fleets in operation, that may seem a little high. But the answer lies in the fact that they are used more. The extra mileage they chalk up—when you consider costs on a cent-per-mile basis—adds up, even though passenger cars are cheaper to operate.

That 35% figure for passenger cars' share in the total fleet is based on the total number of cars reported by the 57 companies as a percent of their total fleets. Although individual company distribution varied quite considerably in some cases, the over-all averages are a reasonable reflection of the general situation.

Light trucks represented the largest class of vehicle with over 40% of the total fleet, and 63% of the total truck fleet. Medium trucks' share was about 15½%, while heavy trucks represented the smallest segment of the whole with 8½% of the total fleet.

An important distinction that the survey pointed up was that between the urban and non-urban utility. For companies with fewer than 25 customers per square mile, the average area served per vehicle amounted to 90.8 square miles. That's practically 10 times the 9.1 square miles per vehicle for the urban companies with an average of 115 customers per square mile.

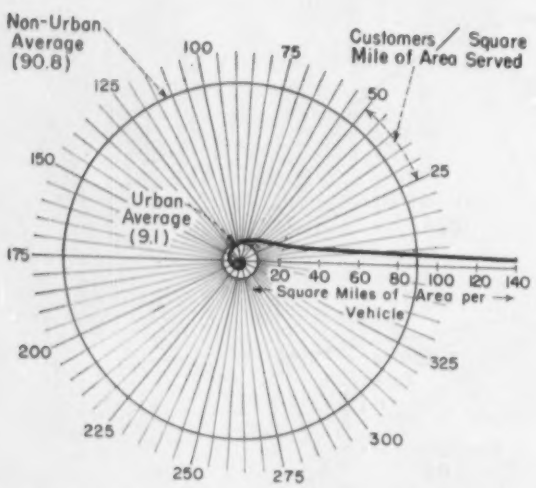
In terms of customers served per vehicle, the more urban utility again had an edge with about 581 customers per vehicle while the non-urban averaged about 531.

Furthermore, in miles of line and cable per vehicle the non-urban utility's vehicle covered just about three times as much as the urban. Averages were 70.1 miles of line and cable per car or truck for the non-urban utility, and 26.3 miles for the urban.

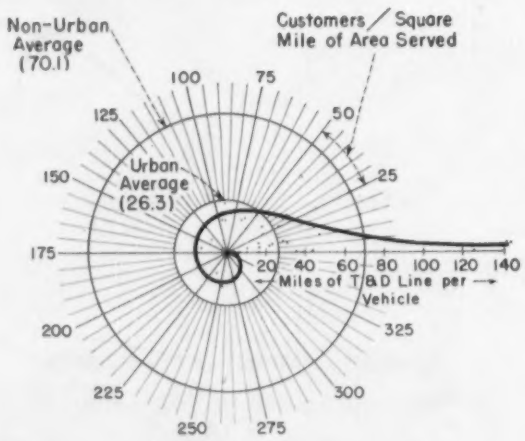
About 10% of utility fleets are replaced each year, according to the survey. That's an average for the whole fleet. Individual classes varied from a high of 13% for passenger cars, with a corresponding average life of about

Customers vs Area Served and Miles of Line per Vehicle

Square Miles of Area Served per Vehicle



Miles of Transmission and Distribution Line per Vehicle



As the number of customers per square mile increases, i.e., as the utility becomes more citified, the area served per vehicle declines. The trend line indicates just how sharply this takes place. The vehicles of a company with 125 customers per square mile, for example, serve an area of about six square miles each, whereas a company with only 4 or 5 customers per square mile is at the tail end of the spiral with each vehicle serving an area 100 miles square. Using 25 customers per square mile as the dividing line between urban and non-urban, averages totalled 9 square miles served per urban vehicle, 91 square miles per non-urban. Similarly in the case of transmission and distribution line, the average declined from 70 miles of line per vehicle for the non-urban to 26 miles for the urban.

7.7 years, to a low of 6.4% for medium trucks and a corresponding life of 15.7 years.

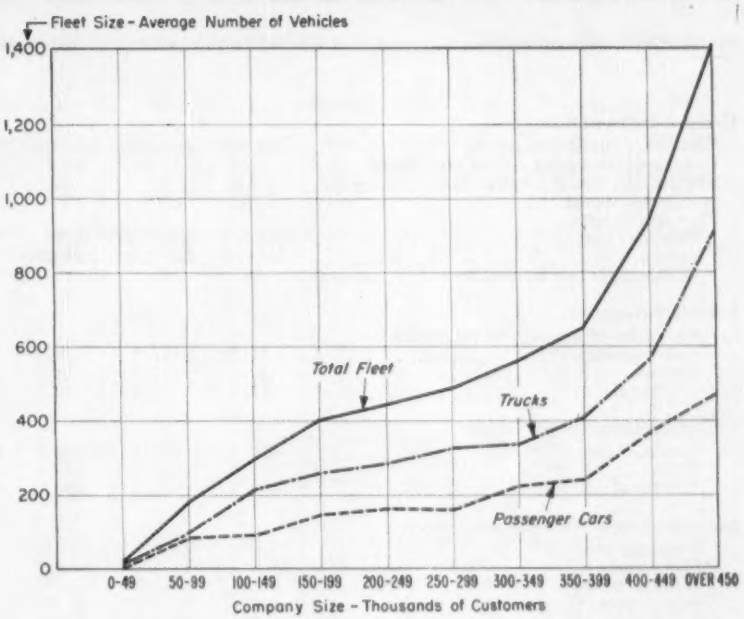
Although one company reported replacements as high as 40% in passenger cars, this was a rare instance. There were more companies at the other extreme, with total fleet replacements as low as 2% and 3% reported for some companies. In terms of specific policies, 40 out of the 57 systems reported a mileage or time basis for replacements.

New vehicles were added at the rate of 4½% a year in 1952. There was not so much variation by class of vehicle in this case, both passenger car and truck additions averaging close to the 4½% figure.

Truck bodies, which represent about 58% of the total truck fleet, follow a replacement pattern similar to the whole fleet—about a 10% turnover every year. Additions are at a higher rate, however, with an average of 6½% added each year.

Out of the wide variety of construction equipment that the utilities reported in use, over 56% were trailers of one kind or another. And of these almost 60% were pole trailers. Actual figures totalled 7,476 pieces of equipment, including 2,383 pole trailers and 1,807 trailers of other types.

More Customers Mean More Vehicles



Highlights of the Survey . . .

- Average cost per mile varies:

  Whole fleet—11¢
  Passenger cars—7.3¢
  Light trucks—9.6¢
  Medium trucks—18.9¢
  Heavy trucks—32.1¢

- Biggest expense items—gas & oil, repairs, depreciation allowance—each about 22% of total cost of operation

- Average mileage per vehicle about 10,600 miles a year—

	Minimum*	Average	Maximum
Passenger cars	8,407	13,311	29,620
Light trucks	6,672	10,539	22,534
Medium trucks	4,131	7,254	16,562
Heavy trucks	1,557	6,037	28,349
Total cars & trucks	7,102	10,571	23,195

- Fleets replaced at an average of 10% a year
- Fleets growing at a 4½% annual rate

- In urban locales (over 25 customers per square mile):

  There's one vehicle for . . .
  every 9 square miles of area served
  every 581 customers
  every 26 miles of transmission and distribution line

	Area per Vehicle—Square Miles		
	Minimum	Average	Maximum
Cars	1.6	27.0	116.5
Trucks	1.2	15.9	42.0
Total	0.7	9.1	26.7

	T & D Line Miles per Vehicle		
	Minimum	Average	Maximum
Cars	13.4	81.4	272.3
Trucks	10.4	43.7	116.0
Total	5.9	26.3	81.3

Average urban fleet size—about 500 cars and trucks

- In non-urban locales (fewer than 25 customers per square mile):

  There's one vehicle for . . .
  every 91 square miles of area served
  every 531 customers
  every 70 miles of transmission and distribution line

	Area per Vehicle—Square Miles		
	Minimum	Average	Maximum
Cars	60.5	197.4	520.0
Trucks	27.9	105.2	292.2
Total	22.8	90.8	292.2

	T & D Line Miles per Vehicle		
	Minimum	Average	Maximum
Cars	45.1	147.3	457.6
Trucks	13.5	80.5	251.5
Total	11.0	70.1	146.1

Average non-urban fleet size—about 285 cars and trucks

- 45 out of 57 utilities reported a preventive maintenance program, either on mileage or time basis
- 40% of the companies surveyed reported driver training programs

* One extreme case omitted

Electrical World Survey of 57 Power Systems

Company	1	2	3	4	5	6	7
General Information							
Customers served (thousands)	200–249	200–249	150–199	450–499	50–99	over 500	200–249
Customers per square mile of area served	35.4	60.5	49.7	31.1	....	9.6	25.4
Electric (E), Gas & Electric (G&E), Co-op (C)	G&E	E	E	E	E	E	E
Geographic region	ENC	ENC	P	SA	P	SA	NE
Fleet size (range)							
Passenger cars	300–399	300–399	1–49	300–399	100–149	400–499	100–149
Trucks	200–299	200–299	200–299	over 500	150–199	over 500	200–299
% Passenger cars in total fleet	59	59	13	38	47	34	26
Vehicle Saturation							
Square miles of area served per vehicle							
Passenger cars	19.2	11.9	81.0	45.2	....	127.2	83.8
Trucks	27.6	17.2	12.5	27.8	....	64.9	29.0
Total	**11.3**	**7.0**	**10.8**	**17.2**	....	**43.0**	**21.5**
Electric customers per vehicle							
Passenger cars	678.2	720.4	4,023.6	1,405.2	459.9	1,221.0	2,132.6
Trucks	975.5	1,042.6	619.0	863.5	404.8	622.5	737.6
Total	**400.1**	**426.0**	**536.5**	**534.9**	**215.3**	**412.3**	**548.1**
Average Annual Mileage per Vehicle							
Passenger cars	13,094	14,629	12,335	15,657	11,076	13,036	13,292
Light trucks†	11,371	12,450	10,887	13,879	9,894	....	12,098
Medium trucks†	5,257	7,198	7,741	7,324	9,553	....	9,200
Heavy trucks†	8,013	7,990	6,095	8,620	7,463	8,179	9,929
Total	**11,793**	**13,119**	**9,661**	**13,843**	**10,084**	**12,024**	**11,879**
Specific Vehicle Replacement Policy							
Passenger cars	None	60 (4)	100 (8)	60 (4)	100 (7–10)	60 (4)	65 (4)
Light trucks	....	70 (4)	100 (8)	70 (4)	100 (10)	60 (5)	65 (4)
Medium trucks	....	(8–10)	100 (10)	(8–10)	100 (10)	60 (8)	65 (5)
Heavy trucks	....	(10)	100 (10)	(10)	100 (10)	....	80 (10)
Operating Expenses—cents per mile							
Total Cost of Operation							
Passenger cars	6.04	....	8.83	....	7.63	6.79	6.08
Light trucks†	9.36	....	10.71	....	11.87	....	8.03
Medium trucks†	17.62	....	22.69	....	17.36	....	16.64
Heavy trucks†	20.82	....	39.71	....	30.08	21.69	19.86
Total	**8.29**	**9.13**	**14.53**	**9.01**	**11.85**	**9.13**	**8.76**
Gas & Oil							
Passenger cars	1.53	....	1.81	....	1.72	2.01	....
Light trucks	2.20	....	2.56	....	2.65	....	....
Medium trucks	2.96	....	4.42	....	3.17	....	....
Heavy trucks	4.64	....	6.98	....	4.03	4.43	....
Total	**1.98**	....	**3.07**	....	**2.35**	**2.38**	....
Tires & Tubes							
Passenger cars	0.29	....	0.30	....	0.44	0.53	....
Light trucks	0.48	....	0.51	....	0.83	....	....
Medium trucks	0.87	....	1.13	....	0.76	....	....
Heavy trucks	1.14	....	3.23	....	2.11	1.95	....
Total	**0.42**	....	**0.80**	....	**0.76**	**0.75**	....
Repairs, Servicing & Accident Cost							
Passenger cars	2.14	....	1.85	....	2.82	1.63	....
Light trucks	3.14	....	2.67	....	4.56	....	....
Medium trucks	7.01	....	6.03	....	6.66	....	....
Heavy trucks	5.85	....	11.50	....	12.92	6.40	....
Total	**2.77**	....	**3.76**	....	**4.64**	**2.38**	....
Other Direct, Allocated Expenses, Overhead							
Passenger cars	0.91	....	3.36	....	0.78	1.23	....
Light trucks	1.46	....	3.24	....	1.17	....	....
Medium trucks	4.56	....	6.01	....	1.90	....	....
Heavy trucks	3.88	....	6.60	....	3.71	2.91	....
Total	**1.35**	....	**3.90**	....	**1.27**	**1.49**	....
Depreciation							
Passenger cars	1.18	....	1.51	....	1.87	1.40	1.94
Light trucks	2.07	....	1.75	....	2.66	....	2.16
Medium trucks	2.22	....	5.11	....	4.86	....	5.62
Heavy trucks	5.31	....	11.41	....	7.31	6.00	5.21
Total	**1.77**	**2.18**	**3.00**	**2.26**	**2.84**	**2.12**	**2.59**

†Vehicle Classifications. Light trucks (including commercial cars) ½ to one ton inclusive, Medium trucks 1½ to two tons inclusive, Heavy trucks over two tons.

Provides Data on Motor Vehicle Fleet Costs

8	9	10	11	12	13	14	15	16	17	18
50–99	200–249	100–149	0–49	350–399	.....	.....	350–399	250–299	100–149	400–449
15.0	67.4	.....	1.8	133.9	.....	.....	360.0	.....	4.7	.....
E	E	E	C	G&E	E	C	G&E	G&E	E	G&E
SA	MA	ESC	WNC	ENC	P	WNC	MA	WSC	P	SA
50–99	150–199	50–99	1–49	300–399	50–99	1–49	over 500	100–149	100–149	1–49
100–149	200–299	150–199	1–49	300–399	over 500	1–49	over 500	400–499	150–199	over 500
38	44	28	33	55	7	25	47	26	35	38
60.5	21.1	.....	2,290.0	7.1	.....	19,000.0	1.6	.....	252.4	.....
36.7	16.3	.....	1,145.0	8.7	.....	6,333.3	1.2	.....	136.8	.....
22.8	9.2	.....	763.3	3.9	.....	4,750.0	0.7	.....	88.7	.....
904.1	1,422.9	2,188.4	4,146.7	956.5	.....	.....	573.2	2,100.7	1,191.8	.....
548.1	1,097.3	847.5	2,073.3	1,164.8	.....	.....	443.3	719.2	646.1	738.6
341.3	619.5	610.9	1,382.2	525.2	.....	.....	250.0	535.7	418.9	688.5
14,818	12,782	16,313	29,150	13,187	15,461	18,992	12,233	12,295	13,263	11,245
11,946	7,885	14,999	20,856	11,938	12,413	16,412	10,553	10,230	8,898	10,908
11,356	7,285	10,796	12,529	7,534	.....	16,562	9,081	.....	9,603	6,725
8,849	10,061	.....	10,275	8,270	.....	22,155	5,687	8,381	3,990	5,539
12,654	10,101	14,788	22,009	11,583	.....	18,511	10,680	10,948	10,421	9,214
(5)	100 (10)	75	None	75 (5)	60 (6)	None	75–100 (5–6)	90	50–65 (7)	60–80 (5–6)
(5)	100 (10)	75	.....	85 (6)	50 (6)	.....	... (5–6)	90	50–70 ...	75 (7–10)
(8–10)	50 (15)	75	.....	75 (8)	60 (7)	.....	... (5–6)	75	75–100 (10–12)	60 (6–10)
(10)	50 (15)	.....	.....	100 (11)	65–80 (8–10)	.....	... (5–6)	75	100–125 (12)	60 (7–10)
6.94	.....	.....	4.36	7.04	5.74	7.27	7.58	7.03	7.18	6.39
9.47	.....	.....	7.98	10.40	6.97	6.91	11.77	8.99	19.68	10.22
12.97	.....	.....	12.34	23.87	.....	4.08	18.28	13.64	21.44	20.94
29.13	.....	.....	56.85	26.58	.....	30.09	30.10	28.59	66.79	36.23
10.03	12.81	8.62	7.87	10.57	.....	13.62	11.05	12.09	10.90	14.28
1.55	.....	.....	1.10	1.43	1.71	.....	1.69	1.64	.....	.....
1.91	.....	.....	2.45	2.13	1.91	.....	3.13	2.37	.....	.....
2.53	.....	.....	3.68	3.66	.....	.....	3.84	2.89	.....	.....
6.14	.....	.....	5.26	4.74	.....	.....	6.13	4.57	.....	.....
2.10	.....	.....	2.01	1.98	.....	.....	2.58	2.57	.....	.....
0.23	.....	.....	.....	.....	0.19	.....	0.33	0.42	.....	.....
0.42	.....	.....	.....	.....	0.23	.....	0.42	0.53	.....	.....
0.63	.....	.....	.....	.....	.....	.....	0.66	0.93	.....	.....
1.25	.....	.....	.....	.....	.....	.....	0.72	1.31	.....	.....
0.41	.....	.....	.....	.....	.....	.....	0.41	0.66	.....	.....
1.65	.....	.....	.....	.....	1.56	.....	2.31	2.56	1.82	.....
2.83	.....	.....	.....	.....	2.35	.....	3.76	3.12	2.85	.....
3.49	.....	.....	.....	.....	.....	.....	6.19	4.39	7.43	.....
8.36	.....	.....	.....	.....	.....	.....	10.33	10.23	32.19	.....
2.76	.....	.....	.....	.....	.....	.....	3.53	4.27	3.38	.....
1.64	.....	.....	0.52	.....	0.98	.....	2.19	0.91	1.04	.....
1.87	.....	.....	0.73	.....	1.18	.....	2.80	1.39	1.41	.....
2.18	.....	.....	2.01	.....	.....	.....	3.04	3.00	2.66	.....
2.83	.....	.....	3.71	.....	.....	.....	4.74	6.23	10.72	.....
1.86	.....	.....	0.80	.....	.....	.....	2.60	2.17	1.53	.....
1.87	.....	.....	2.01	1.12	1.30	.....	1.07	1.50	0.92	1.83
2.43	.....	.....	3.24	2.52	1.30	.....	1.66	1.58	0.88	2.09
4.13	.....	.....	4.93	8.64	.....	.....	4.56	2.43	2.10	5.09
10.56	.....	.....	46.88	7.95	.....	.....	8.18	6.26	4.66	10.99
2.89	2.67	1.70	3.87	2.61	.....	.....	1.93	2.42	1.12	3.42

Data Show Average Number of Customers and

Company	19	20	21	22	23	24	25
General Information							
Customers served (thousands)	250–299	50–99	150–199	over 500	200–249	50–99	400–499
Customers per square mile of area served	467.7	165.2	88.7	16.4	....	9.3	238.7
Electric (E), Gas & Electric (G&E), Co-op (C)	E	E	G&E	G&E	G&E	E	E
Geographic region	SA	MA	MA	P	ENC	WNC	ENC
Fleet size (range)							
Passenger cars	150–199	50–99	200–299	over 500	50–99	50–99	300–399
Trucks	200–299	1–49	150–199	over 500	400–499	100–149	300–399
% Passenger cars in total fleet	42	64	56	36	18	45	47
Vehicle Saturation							
Square miles of area served per vehicle							
Passenger cars	3.6	8.3	8.7	.....	....	87.2	5.1
Trucks	2.6	14.5	11.0	27.9	....	72.1	4.6
Total	1.5	5.3	4.8	.....	....	39.4	2.4
Electric customers per vehicle							
Passenger cars	1,660.2	1,377.7	774.8	.....	2,307.6	812.9	1,233.3
Trucks	1,205.0	2,402.1	975.1	457.8	505.9	672.2	1,102.6
Total	698.2	875.5	431.7	.....	414.9	367.9	584.6
Average Annual Mileage per Vehicle							
Passenger cars	10,408	8,407	16,621	12,143	.....	13,353	12,550
Light trucks†	12,117	8,761	13,305	10,829	.....	10,102	.....
Medium trucks†	5,577	.....	9,699	6,591	.....	5,590	.....
Heavy trucks†	5,366	4,064	6,478	5,567	.....	28,349	16,411
Total	9,464	7,846	14,294	10,183	12,101	11,222	9,701
Specific Vehicle Replacement Policy							
Passenger cars (Thousands of miles, (years))	None	50 (4–5)	40 (3)	None	100–125	80	60 (4–5)
Light trucks (Thousands of miles, (years))	.....	50 (5–6)	60 (5)	.....	100–125	80	60 (6)
Medium trucks (Thousands of miles, (years))	.....	... (7–10)	60 (5–7)	.....	100–125	80	... (7–9)
Heavy trucks (Thousands of miles, (years))	.....	... (10–12)	... (10)	.....	100–125	80–120	... (10–12)
Operating Expenses—cents per mile							
Total Cost of Operation							
Passenger cars	10.61	7.36	5.46	7.45	.....	6.24	.....
Light trucks†	11.52	9.03	13.49	9.01	.....	.....	.....
Medium trucks†	31.16	.....	24.83	23.44	.....	.....	.....
Heavy trucks†	60.15	21.94	46.52	42.49	.....	.....	.....
Total	16.31	8.59	10.12	10.98	8.21	7.99	15.04
Gas & Oil							
Passenger cars	1.42	.....	.....	1.83	.....	.....	1.57
Light trucks	2.58	.....	.....	2.33	.....	.....	.....
Medium trucks	4.50	.....	.....	4.54	.....	.....	.....
Heavy trucks	6.10	.....	.....	7.61	.....	.....	3.54
Total	2.47	.....	.....	2.52	2.03	.....	2.33
Tires & Tubes							
Passenger cars	.....	.....	.....	0.51	.....	.....	0.24
Light trucks	.....	.....	.....	0.70	.....	.....	.....
Medium trucks	.....	.....	.....	2.19	.....	.....	.....
Heavy trucks	.....	.....	.....	4.31	.....	.....	1.01
Total	.....	.....	.....	0.89	0.56	.....	0.54
Repairs, Servicing & Accident Cost							
Passenger cars	.....	.....	.....	2.11	.....	.....	3.35
Light trucks	.....	.....	.....	2.67	.....	.....	.....
Medium trucks	.....	.....	.....	7.89	.....	.....	.....
Heavy trucks	.....	.....	.....	15.42	.....	.....	8.39
Total	.....	.....	.....	3.39	2.44	.....	5.29
Other Direct, Allocated Expenses, Overhead							
Passenger cars	1.62	.....	.....	1.75	.....	1.57	.....
Light trucks	1.49	.....	.....	1.88	.....	.....	.....
Medium trucks	4.15	.....	.....	4.21	.....	.....	.....
Heavy trucks	6.86	.....	.....	5.74	.....	.....	.....
Total	2.18	.....	.....	2.23	1.49	2.00	6.83
Depreciation							
Passenger cars	1.24	.....	1.61	1.21	.....	1.00	.....
Light trucks	1.22	.....	1.38	1.43	.....	.....	.....
Medium trucks	4.14	.....	3.09	4.59	.....	.....	.....
Heavy trucks	12.29	.....	12.01	9.40	.....	.....	.....
Total	2.25	.....	1.99	1.94	1.70	1.00	.....

† Vehicle Classifications: Light trucks (including commercial cars) ½ to one ton inclusive, Medium trucks 1½ to two tons inclusive, Heavy trucks over two tons.

Square Miles of Territory Served per Vehicle

26	27	28	29	30	31	32	33	34	35	36	37
350–399	150–199	200–249	200–249	300–349	50–99	200–249	0–49	0–49	0–49	0–49	50–99
8.7	7.7	94.3	49.9	11.5	52.9	39.6	88.5	2.2	4.3	93.9	27.1
E	E	E	G&E	G&E	E	E	E	C	C	E	E
ESC	SA	P	P	SA	MA	WNC	ESC	ENC	ENC	SA	ESC
200–299	150–199	100–149	150–199	150–199	50–99	50–99	1–49	1–49	None	1–49	1–49
over 500	300–399	200–299	200–299	300–399	50–99	200–299	1–49	1–49	1–49	1–49	50–99
29	33	30	37	32	63	30	28	31	0	49	23
167.9	127.1	19.4	34.0	178.5	14.4	63.1	29.4	520.0	.....	15.2	116.5
69.0	63.2	8.5	24.8	87.5	24.4	26.9	11.4	236.4	135.6	14.7	35.1
48.9	42.2	5.9	14.8	58.7	9.0	18.8	8.2	162.5	135.6	7.4	26.7
1,466.0	973.6	1,837.8	1,698.5	2,055.4	766.3	2,500.2	2,605.4	1,134.0	.....	1,431.5	3,159.4
602.3	483.8	803.2	1,239.0	1,006.7	1,660.2	1,064.7	1,013.27	515.5	567.5	1,383.8	941.1
426.9	323.2	558.9	741.6	675.7	480.8	746.7	729.5	354.3	567.5	703.6	725.1
16,503	14,271	11,077	14,699	13,258	.....	.....	12,739	15,023	.....	12,052	15,604
13,983	11,768	10,395	11,773	13,039	11,617	.....	12,043	16,057	15,943	11,864	16,128
7,947	6,254	6,474	9,171	9,597	.....	.....	6,606	8,686	11,036	5,681	11,134
8,913	5,005	5,875	7,932	5,995	8,499	.....	.....	.....	.....	.....	5,899
13,607	11,210	9,031	11,947	12,330	10,843	.....	11,368	13,891	16,234	11,223	15,265
70 (4–5)	100 (5)	None	None	None	None	None	70 (4)	50	.....	60 (4)	60 (4)
70 (4–5)	75 (5)	.....	.....	.....	.....	.....	70 (4)	50–60	(3)	70 (5)	70 (4)
70 (4–5)	60–75 (5–6)	.....	.....	.....	.....	.....	... (8–10)	.....	(3)	... (8–10)	... (8–10)
70 (4–5)	50–60 (5–6)	.....	.....	.....	.....	.....	... (10)	.....	.....	... (10)	... (10)
4.98	6.81	.....	8.12	6.11	7.52	.....	.....	6.66	.....	.....	.....
7.78	9.07	.....	11.06	8.97	.....	.....	.....	7.17	10.41	.....	.....
20.69	18.91	.....	19.86	16.64	.....	.....	.....	18.94	18.44	.....	.....
23.22	21.67	.....	32.65	26.25	21.74	.....	.....	.....	.....	.....	.....
8.53	9.39	16.00	12.67	9.30	10.29	.....	10.62	8.83	11.13	9.93	8.87
1.71	1.87	1.95	.....	.....	1.85	.....	.....	1.81	.....	.....	.....
2.69	2.49	2.54	.....	.....	.....	.....	.....	2.37	3.00	.....	.....
4.73	5.23	5.33	.....	.....	.....	.....	.....	3.70	3.31	.....	.....
5.50	4.96	9.30	.....	.....	3.82	.....	.....	.....	.....	.....	.....
2.65	2.54	3.39	.....	.....	2.23	.....	.....	2.39	3.03	.....	.....
0.38	0.31	.....	.....	.....	0.48	.....	.....	0.07	.....	.....	.....
0.60	0.57	.....	.....	.....	0.67	.....	.....	0.85	0.82	.....	.....
1.81	2.22	.....	.....	.....	.....	.....	.....	0.49	0.49	.....	.....
1.78	2.76	.....	.....	.....	1.49	.....	.....	.....	.....	.....	.....
0.67	0.68	.....	.....	.....	0.67	.....	.....	0.53	0.79	.....	.....
0.98	1.63	.....	.....	.....	2.67	.....	.....	.....	.....	.....	.....
2.05	2.74	.....	.....	.....	.....	.....	.....	.....	1.86	.....	.....
6.84	8.18	.....	.....	.....	.....	.....	.....	.....	3.96	.....	.....
6.10	9.71	.....	.....	.....	7.09	.....	.....	.....	.....	.....	.....
2.21	2.98	.....	.....	.....	3.53	.....	.....	.....	2.05	.....	.....
0.84	1.50	.....	.....	0.97	1.45	.....	.....	.....	.....	.....	.....
1.19	1.50	.....	.....	0.87	.....	.....	.....	.....	.....	.....	.....
2.86	1.49	.....	.....	2.33	.....	.....	.....	.....	.....	.....	.....
4.13	2.09	.....	.....	4.72	3.94	.....	.....	.....	.....	.....	.....
1.35	1.53	.....	4.03	1.15	1.94	.....	.....	.....	.....	.....	.....
1.08	1.49	1.82	1.23	1.02	1.09	.....	.....	.....	.....	.....	.....
1.25	1.77	2.22	2.48	1.49	.....	.....	.....	.....	4.72	.....	.....
4.47	1.78	5.63	4.61	2.51	.....	.....	.....	.....	10.67	.....	.....
5.71	2.17	15.01	9.97	5.24	5.40	.....	.....	.....	.....	.....	.....
1.67	1.68	3.76	2.84	1.51	1.93	.....	2.91	.....	5.26	2.67	1.87

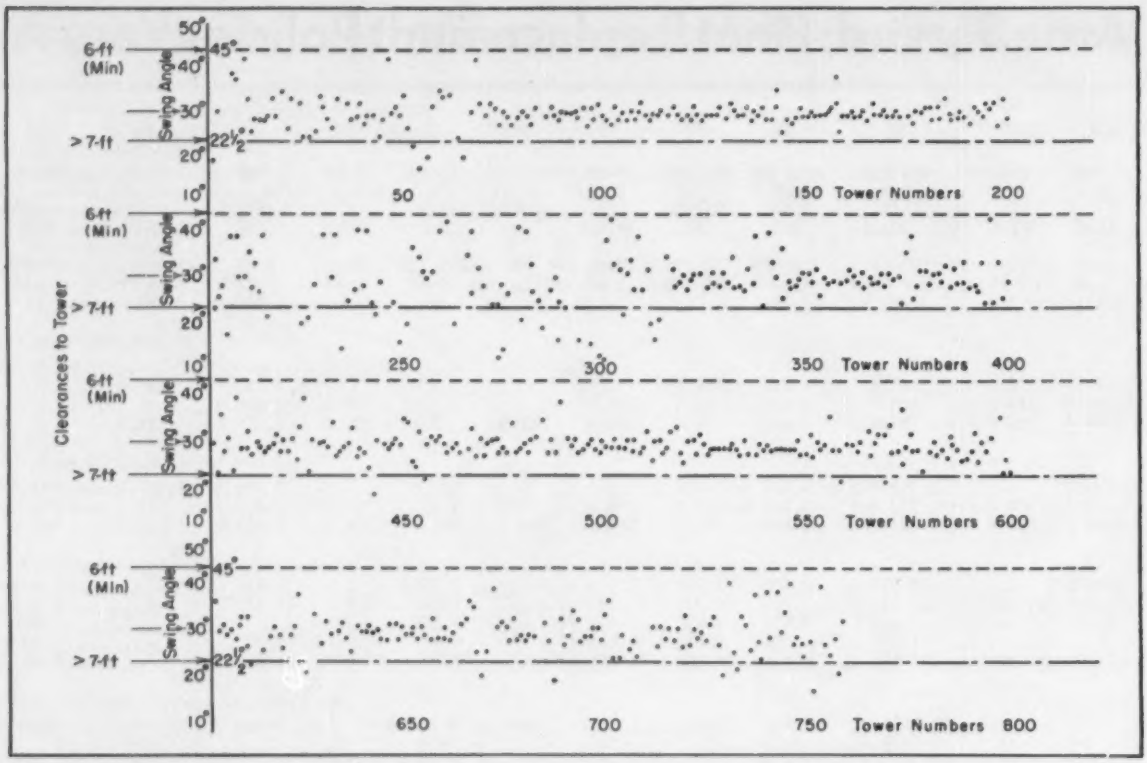
Average Annual Mileage per Vehicle Reflects

Company	38	39	40	41	42	43	44	45
General Information								
Customers served (thousands)	350–399	50–99	over 500	300–349	0–49	150–199	0–49	400–449
Customers per square mile of area served	62.9	50.7	.....	25.6	.....	254.9	.....	192.8
Electric (E), Gas & Electric (G&E), Co-op (C)	E	E	E	E	C	G&E	C	G&E
Geographic region	ENC	MA	P	MA	MA	ESC	NE	SA
Fleet size (range)								
Passenger cars	400–499	50–99	over 500	200–299	1–49	1–49	None	300–399
Trucks	400–499	50–99	over 500	300–399	1–49	100–149	1–49	over 500
% Passenger cars in total fleet	53	52	35	48	6	22	0	38
Vehicle Saturation								
Square miles of area served per vehicle								
Passenger cars	12.3	20.3	.....	45.9	.....	21.4	.....	5.7
Trucks	13.9	21.9	.....	42.0	.....	5.6	.....	3.5
Total	6.5	10.5	.....	21.9	.....	4.4	.....	2.1
Electric customers per vehicle								
Passenger cars	774.4	1,030.3	.....	1,174.7	5,880.0	5,462.5	.....	1,112.2
Trucks	875.0	1,108.5	.....	1,075.2	392.0	1,429.4	429.3	670.3
Total	410.8	534.0	.....	561.3	367.5	1,132.9	429.3	418.2
Average Annual Mileage per Vehicle								
Passenger cars	13,083	12,048	9,203	11,331	28,160	15,016	.....	17,535
Light trucks†	11,563	15,035	.....	.....	18,159	16,437	13,122	10,158
Medium trucks†	7,557	11,418	.....	.....	8,205	11,968	.....	8,449
Heavy trucks†	9,555	8,129	.....	.....	1,557	7,244	6,995	5,905
Total	11,826	11,650	7,102	9,858	15,258	13,190	10,671	10,091
Specific Vehicle Replacement Policy								
Passenger cars	60 (4)	(6)	35–50 (2½–5)	(7)	60 (2)	None	None	60
Light trucks	70 (5)	(6)	.....	(7–9)	100 (4)	.....	.....	60
Medium trucks (Thousands of miles, (years))	... (8–10)	(10)	.....	(8–10)	... (5)	.....	.....	50–60
Heavy trucks	... (10)	(10)	.....	(8–12)	... (5)	.....	.....	50
Operating Expenses—cents per mile								
Total Cost of Operation								
Passenger cars	.....	.....	12.18	9.72	7.57	6.20	.....	8.09
Light trucks†	.....	.....	15.83	.....	6.85	7.27	8.91	10.47
Medium trucks†	.....	.....	28.37	.....	13.10	12.66	.....	18.50
Heavy trucks†	.....	.....	54.86	.....	16.13	29.59	15.80	36.23
Total	9.41	15.65	19.65	12.09	7.84	10.64	10.71	11.90
Gas & Oil								
Passenger cars	.....	.....	1.24	.....	2.19	1.85	.....	.....
Light trucks	.....	.....	1.55	.....	1.90	2.24	2.37	.....
Medium trucks	.....	.....	2.21	.....	2.48	3.48	.....	.....
Heavy trucks	.....	.....	3.88	.....	3.88	5.73	5.17	.....
Total	.....	2.22	1.73	.....	2.03	2.80	3.10	.....
Tires & Tubes								
Passenger cars	.....	.....	0.40	.....	0.64	0.43	.....	0.65
Light trucks	.....	.....	0.57	.....	0.61	0.58	1.48	0.72
Medium trucks	.....	.....	1.40	.....	1.07	1.10	.....	0.95
Heavy trucks	.....	.....	3.57	.....	0.00	1.39	1.07	1.99
Total	.....	0.73	0.90	.....	0.67	0.75	1.37	0.78
Repairs, Servicing & Accident Cost								
Passenger cars	.....	.....	3.77	.....	1.33	1.63	.....	3.43
Light trucks	.....	.....	5.56	.....	1.40	1.83	2.62	4.26
Medium trucks	.....	.....	9.62	.....	3.20	2.88	.....	6.88
Heavy trucks	.....	.....	19.24	.....	6.37	5.45	6.75	11.22
Total	.....	.....	6.64	.....	1.67	2.41	3.70	4.64
Other Direct, Allocated Expenses, Overhead								
Passenger cars	.....	.....	4.96	.....	0.21	1.09	.....	.....
Light trucks	.....	.....	5.70	.....	0.53	1.06	0.63	.....
Medium trucks	.....	.....	9.92	.....	1.34	2.70	.....	.....
Heavy trucks	.....	.....	19.75	.....	5.88	9.18	1.48	.....
Total	.....	.....	7.30	.....	0.64	2.32	0.85	.....
Depreciation								
Passenger cars	.....	.....	1.80	0.61	3.21	1.19	.....	0.90
Light trucks	.....	.....	2.45	.....	2.41	1.55	1.81	1.72
Medium trucks	.....	.....	5.22	.....	5.01	2.50	.....	4.72
Heavy trucks	.....	.....	8.42	.....	.....	7.89	1.34	11.64
Total	2.07	3.04	3.09	1.55	2.83	2.36	1.68	2.30

Vehicle Classifications: Light trucks (including commercial cars) ½ to one ton inclusive, Medium trucks 1½ to two tons inclusive, Heavy trucks over two tons.

Area Served; Fleet Replacement Policies Vary

46	47	48	49	50	51	52	53	54	55	56	57
0–49	0–49	100–149	over 500	200–249	0–49	over 500	50–99	0–49	0–49	50–99	50–99
0.5	5.6	3.3	4,684.6	14.2	2.0	44.3	176.6	1.3	1.3	11.0	.....
C	C	G&E	G&E	G&E	C	G&E	G&E	C	C	G&E	G&E
WSC	ENC	M	MA	M	WNC	MA	SA	WNC	WNC	NE	NE
1–49	None	100–149	150–199	50–99	None	.....	100–149	None	1–49	1–49	100–149
1–49	1–49	300–399	over 500	400–499	1–49	.....	50–99	1–49	1–49	100–149	100–149
21	0	22	16	17	0	.....	60	0	23	33	48
3,750.0	.....	366.3	3.5	181.8	.....	.....	3.9	.....	4,285.7	102.0	.....
1,000.0	100.0	100.6	0.6	36.5	181.8	.....	5.9	292.2	1,578.9	42.4	.....
789.4	**100.0**	**82.0**	**0.1**	**30.4**	**181.8**	**11.9**	**2.3**	**292.2**	**1,153.8**	**34.2**	.....
1,921.7	.....	1,191.0	16,437.4	2,581.2	.....	.....	683.0	.....	5,579.0	1,117.5	932.2
512.5	558.5	343.7	3,082.0	518.5	364.1	.....	1,043.1	366.9	2,055.4	542.2	858.6
404.5	**558.5**	**266.7**	**2,595.4**	**431.8**	**364.1**	**528.9**	**412.8**	**366.9**	**1,502.0**	**365.1**	**447.0**
29,620	.....	13,325	2,593	11,216	.....	.....	9,855	.....	25,456	.....	10,958
22,534	19,013	11,261	2,735	10,304	17,073	.....	9,553	18,611	12,053	.....	6,672
6,740	8,766	7,461	2,122	8,832	7,472	.....	6,378	4,131	.....	.....	7,276
.....	.....	11,719	61	5,873	8,914	.....	6,502	13,771	2,509	.....	5,507
23,195	**16,451**	**11,151**	**1,934**	**10,075**	**15,626**	**11,171**	**9,267**	**13,930**	**12,961**	.....	**8,615**
75	.....	50–70 (3–5)	None	None	.....	None	70 (5)	.....	None	75–100 (6)	None
60	(3)	50–70 (3–5)	.....	.....	(3)	.....	70 (5)	(3)	.....	75–100 (6)	.....
75	(6)	50–70 (5–7)	.....	.....	(6)	.....	70 (5)	(3)	.....	75–100 (6)	.....
.....	.....	100 (10)	.....	.....	(6)	.....	100 (10)	(3)	.....	100–150 (6)	.....
5.11	.....	7.37	.....	10.60	.....	.....	8.94	.....	.....	.....	7.39
6.53	5.54	13.04	.....	12.36	7.75	.....	11.15	8.14	.....	.....	10.75
22.74	12.46	32.74	.....	.....	17.49	.....	18.70	14.32	.....	.....	18.66
.....	.....	28.65	.....	.....	35.52	.....	30.75	25.88	.....	.....	23.55
6.40	**6.46**	**15.46**	.....	**13.78**	**11.05**	**11.11**	**11.16**	**9.76**	**13.60**	.....	**10.60**
1.64	.....	.....	.....	.....	.....	.....	1.80	.....	.....	.....	.....
1.83	2.37	.....	.....	.....	2.36	.....	2.28	.....	.....	.....	.....
2.50	3.75	.....	.....	.....	4.15	.....	2.99	.....	.....	.....	.....
.....	.....	.....	.....	.....	4.89	.....	6.17	.....	.....	.....	.....
1.79	**2.56**	.....	.....	.....	**2.70**	**2.47**	**2.21**	.....	**3.69**	.....	.....
0.29	.....	.....	.....	.....	.....	.....	0.32	.....	.....	.....	0.45
0.44	0.45	.....	.....	.....	0.79	.....	0.38	.....	.....	.....	0.45
0.51	0.90	.....	.....	.....	2.13	.....	1.09	.....	.....	.....	1.37
.....	.....	.....	.....	.....	0.15	.....	4.70	.....	.....	.....	1.01
0.40	**0.51**	.....	.....	.....	**0.78**	.....	**0.61**	.....	.....	.....	**0.63**
1.09	.....	1.47	.....	.....	.....	.....	2.20	.....	.....	.....	.....
1.52	0.58	2.44	.....	.....	1.04	.....	2.85	.....	.....	.....	.....
10.55	1.80	6.23	.....	.....	4.55	.....	4.60	.....	.....	.....	.....
.....	.....	5.06	.....	.....	2.47	.....	7.70	.....	.....	.....	.....
1.54	**0.74**	**2.89**	.....	.....	**1.34**	.....	**2.78**	.....	.....	.....	.....
.....	.....	1.95	.....	0.73	.....	.....	2.99	.....	.....	.....	.....
.....	0.73	5.95	.....	0.82	0.74	.....	3.10	.....	.....	.....	.....
.....	2.37	14.19	.....	.....	1.91	.....	4.88	.....	.....	.....	.....
.....	.....	11.30	.....	.....	2.46	.....	5.49	.....	.....	.....	.....
.....	**0.94**	**6.39**	.....	**0.95**	**0.98**	.....	**3.25**	.....	.....	.....	.....
2.09	.....	1.15	.....	2.77	.....	.....	1.63	.....	.....	.....	.....
2.74	1.42	1.00	.....	2.60	2.82	.....	2.54	2.79	.....	.....	.....
9.18	3.66	4.91	.....	.....	4.77	.....	5.14	0.15	.....	.....	.....
.....	.....	6.60	.....	.....	25.55	.....	6.70	13.06	.....	.....	.....
2.67	**1.72**	**2.11**	.....	**3.11**	**5.26**	**2.04**	**2.31**	**3.17**	**4.31**	.....	.....



CALCULATED SWING ANGLES at suspension towers are indicated by points for single-circuit, 287-kv tower line, operating initially at 230 kv. Total length is 165 miles; 16-insulator string, 5¾ x 10-in. units, 1.382-in. diameter ACSR conductor in the swing position

Clearances Can Be Designed to Cut

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A realistic approach to electrical clearances for higher voltage transmission lines points to new minimum tower weights and to economies that are important to progress in power transmission. Net savings in weight of tower can be estimated as ranging from 5 to 10%, depending upon the actual design. Moreover, the new design features result in a reduction of line impedance which in itself can be of considerable economic significance.

Study also shows that the clearances and swing angles specified by the National Electrical Safety Code are too high for application to line design for the higher transmission voltages. The NESC rules were developed for low and medium voltage transmission. Apparently, they do not differentiate for the conditions at the higher voltages, in which large conductors are used and systems invariably operate with the neutral solidly grounded.

NESC rules specify a minimum clearance to tower of 6 ft 4 in., corresponding to a 45-degree swing, for a 288-kv line. These specifications, in the light of present knowledge and requirements, can be reduced in many applications to 5 ft 1 in. and a 35-degree swing. For an insulator string of 16 units, such as is normally used for 288 kv, a shortening in the width of tower crossarm of about 8 ft for single-circuit tower design can be effected.

Safety is an important factor in all high-voltage design and always should receive foremost attention. There is, however, a pressing need to reexamine NESC rules to determine whether they continue to prescribe effective safety rules without unduly penalizing progress in the power transmission field.

Service Conditions . . . In determining the insulation and electrical clearance requirements for designing high-voltage transmission lines, three voltage conditions must be considered. These are 60-cps voltages, switching and similar transient overvoltages, and lightning. To secure the most economical and effective design, these conditions must be evaluated quantitatively with reference to the following principal factors influencing operation of the line:

1. Action of the wind in reducing

Table I — Expectancy Distribution of Switching Overvoltages for HV System

Line-to-Neutral Crest (Multiple)	Percent Distribution
2.5 (maximum)	Practically none
2.5 to 2.0	5
2.0 to 1.5	10
Less than 1.5 (>1.25)	85

• Adapted from a paper delivered before the summer general meeting of the AIEE, June 21-25, 1954

Table II—Electrical Clearances Required for Switching Over-voltages

Voltage Class	Switching Overvoltages 2.5 Times 60-Cycle Crest	Full Wave Impulse Voltage Equivalent	Design Strength Full Wave (1½ x 40 MS)	Permissible Clearances Conductor to Tower
(1)	(2)	(3)	(4)	(5)
230 KV (242)	495 KV	550 KV	765 KV	48 in.
288 KV (302)	620 KV	690 KV	960 KV	61 in.
345 KV (362)	740 KV	825 KV	1150 KV	74 in.

Table III—Electrical Clearances Required for Switching Overvoltages 2.5, 2.75 and 3.0 Times Line-to-Neutral Voltage (ELN)

Voltage Class	Clearances for Switching Overvoltages		
	2.5 x E_{LN}	2.75 x E_{LN}	3.0 x E_{LN}
230 KV (242)	48 in.	53 in.	58 in.
288 KV (302)	61 in.	67 in.	74 in.
345 KV (362)	74 in.	82 in.	90 in.

EHV Tower Weights

clearances by swinging conductors together and to the tower structure.

2. Reduced clearances to ground and the interference of foreign or adjacent objects, requiring measures in addition to adequates clearances, such as right-of-way clearing.

3. Upswing of conductors in a vertical wind or as a result of convection effects, galloping and dancing of the conductors resulting from unloading of sleet and snow, and similar factors present in certain geographical regions and topographical conditions, which affect the spacing between conductors especially at midspan.

4. Safety requirements, including national and state codes.

5. "Hot-line" maintenance.

6. Effect of spacing of conductors on the impedances and capacitances of the line, and on radio influence and corona.

7. The application of rapid-clearing and reclosing breakers is a factor in transmission design, conducive to the acceptance of reduced clearances for unusual conditions of operation, such as may result from maximum sideswing of conductors and insulator assemblies under high wind and other abnormal conditions.

Switching Overvoltages . . . Switching overvoltages are a paramount consideration in determining electrical clearance requirements at tower structures. An interconnected system of modern design operates with the neutral solidly grounded and provided with breakers free of restrike. System studies and operating experience indicate that on such a system overvoltages from line to ground seldom attain 2.5 line-to-ground crest voltage.

Based on this finding, an expectancy distribution curve was constructed for the switching overvoltages given in Table I. This curve established the permissible electrical clearances required at the tower.

Another important factor in determining clearances from an insulator assembly to the tower structure is the dielectric strength of the air to switching overvoltages. The dielectric strength of air to switching surges in relation to the impulse strength, according to recent experimental data, is in the ratio of 9 to 10.

Clearances to Tower . . . The clearances for 2.5 times line-to-neutral switching overvoltages are derived in Table II. Column 1 gives the rated voltage and in parenthesis the maximum operating voltage, nominally set at 5% above the rated voltage. The switching overvoltages in Column 2 are based on the maximum operating voltages in Column 1. Column 2 multiplied by 10/9 gives the corresponding full-wave impulse voltage equivalents in Column 3.

In calculating the required strength, an allowance of 10% (1.10 factor) is made between withstand voltage and critical (50%) sparkover of air. An additional 10% (1.10 factor) is allowed for nonstandard atmospheric conditions and similar effects. Finally, a 15% margin (1.15 factor of safety) is applied.

Thus, Column 3 is multiplied by 1.10 x 1.10 x 1.15 to obtain Column 4. On this basis the electrical clearances required to tower for a given sideswing of the insulator assembly are given in Column 5. The clearances corespond to point-to-point electrode data and positive polarity of the voltage.

Conditions Less Favorable . . . The clearances in Table II assume that switching overvoltages in excess of 2.5 times line-to-neutral are rare. These clearances apply to operating conditions that may obtain in a modern interconnected system with no-restrike circuit breakers and which are equipped to limit the 60-cps dynamic overvoltages.

When system conditions are not so favorable and are conducive to higher switching overvoltages, correspondingly greater clearances would be necessary. Table III gives the electrical clearances required for switching overvoltages to a maximum of 2.75 and 3.0 times line-to-ground voltage. These clearances were derived by the same procedure as the values in Table II.

The spacing permissible between line conductor and tower depends on the probability of simultaneous occurrence of maximum switching over-

Table IV—Proposed Clearances vs Present NESC Rules

Voltage Class-KV	Proposed Clearances (Table II)		Present Rules NESC	
	Minimum Clearances-in	Swing Angle-Degrees	Minimum Clearances	Swing Angle-Degrees
230 (242)	4 ft.	35	5 ft. 1 in.	45
288 (302)	5 ft. 1 in.	35	6 ft. 4 in.	45
345 (362)	6 ft. 2 in.	35	7 ft. 7 in.	45

voltages and maximum sideswing of the insulator string. Consequently, the selection of effective and economical spacings depends very largely upon a realistic evaluation of these two factors.

In a well-balanced design these combined factors should encroach unduly rarely if ever on the strength of the air between conductor and tower. An appraisal of permissible minimum spacings requires consideration of probable maximum swing of insulator assembly.

Maximum Swing . . . To determine probable maximum swing angles encountered in practice, a 165-mi, single-circuit, steel-tower line designed for 287 kv, but scheduled initially to operate at 230 kv (see opening illustration), was selected as a reference for study. The line traverses both mountainous terrain and open country and follows a valley for many miles, encountering a wide variety of topographical and climatic conditions. Load data for the line correspond to an 8-lb wind per sq ft (nominal 60 mph) and to ½-in. ice at 0 degrees F., which is the criterion of design in determining maximum swing (limited, not to exceed 45 degrees).

Spot checks showed that swing angles of the unloaded conductor in an 8-lb wind do not exceed swing angles in ice-loading conditions. The following inferences were drawn regarding maximum swing angles with a 60-mph wind transversing the line on which 758 suspension structures were examined:

1. Tower structures in which swing angles come within the limits of 40 to 45 degrees are only 4.2%.

2. Structures in which the swing angle is greater than 35 degrees comprise about 8.6% of the total.

3. Swing angles greater than 35 degrees are scattered over the entire length of the line (165 mi), with some tendency to cluster in certain sections of the line, where presumably prevailing topography, terrain and other factors contribute to the large swing angles.

4. The average swing angle for the entire line is in the order of 30 degrees.

Simultaneous Occurrence . . . The 165-mi line extends from eastern Washington to western Montana. Only a small part is affected annually by wind velocities approaching 60 mph. and the direction of the wind is not likely to be uniformly transversal to a line of such length. Consequently, only a limited number of insulator strings can be subjected to swing angles as great as 40 or 45 degrees at any one time and then only for minutes.

Such a line may experience annually some 100 switching overvoltages above 1.25 times line-to-ground crest. According to Table I, overvoltages of the magnitude of 2.5 times line-to-ground would be few. Good operating practices and circuit breakers of good performance would further reduce such overvoltages. Severe system disturbances and abnormal meteorological conditions bear a correlation to each other. But, in view of the infrequency of occurrence and the short times involved, the probability of simultaneous maximum swing and maximum switching overvoltages is very small. The concurrence of these factors would hardly be more than once or twice yearly for the entire 165-mi. line.

Swing Angle Selection . . . In high-voltage transmission line design, permissible spacings can be based realistically on a 35-degree swing angle. Then the air clearances from conductor (clamp or grading shield) to tower at 35-degree sideswing are proportioned to maximum switching overvoltage (Table III). When a 45-degree swing and maximum switching overvoltage occur simultaneously, the strength of the air would be encroached upon. But, in view of the infrequency of such concurrence, good engineering practice accepts the risk to secure the economic gain resulting from this procedure in design. The risk of probable sparkover from conductor to tower at 45-degree swing angle is even more acceptable when fast clearing and reclosing circuit breakers are in use.

Pyramiding Margins . . . The electrical clearances in Table III are realistic for the conditions of service and system operation stated. They are valid for altitudes not exceeding 1,500 to 2,500 ft. Higher altitudes may require additional allowances. These, it must be understood, are electrical clearances with no allowance for mechanical variations and other design requirements. In deriving them, unnecessary compounding of margins and safety factors was avoided. Such compounding would be the antithesis of a good engineering and economic approach.

Table V—Maximum (5-min) Wind

Year	1912	13	14	15	16	17
Tatoosh Island, Wash.	68	51	65	61	68	54
North Head, Wash.	69	65	70	63	73	65
Eureka, Calif.	35	35	46	46	35	35
Baker, Ore.	27	30	39	28	28	30
Fresno, Calif.*	30	30	32	35	41	28
Winnemucca, Nev.	36	32	36	32	38	41
Yuma, Ariz.	32	32	29	32	32	37
Williston, N. D.	38	50	40	35	38	41
Sheridan, Wyo.	44	38	41	43	40	38
Valentine, Nev.	38	44	44	43	39	36
Oklahoma City, Okla.	56	41	44	57	48	43
Roswell, N. Mex.*	37	50	38	47	38	38
Corpus Christi, Tex.	47	41	41	40	90	38
Duluth, Minn.	54	49	49	46	50	45
Peoria, Ill.*	30	38	28	30	30	32
Cairo, Ill.	35	38	33	35	40	38
Birmingham, Ala.*	34	32	32	32	35	30
Alpena, Mich.	38	43	41	39	41	38
Canton, N. Y.	51	53	50	44	46	47
Burlington, Vt.	40	47	43	40	41	50
Eastport, Me.	53	41	54	49	60	54
Block Island, R. I.	60	54	65	66	56	59
Richmond, Va.	46	49	41	43	37	47
Charleston, S. C.	52	49	46	43	50	37
Key West, Fla.	32	40	39	44	41	40

* Wind Extremes as Design Factors, Arnold Court. Journ

Variations and uncertainties inherent in the respective factors offset each other in some measure and are not accumulative. When all factors, such as ratio of impulse to switching, withstand to critical sparkover, etc, are combined in the derivation (Table II), their respective inherent variations are not effective at the same time and do not add simultaneously.

When a greater degree of conservatism is imposed on the designer, some compounding of margins and factors of safety may be warranted. If such is the case, the ratio of withstand strength to critical sparkover may be increased to 1.15 as a further means of narrowing down the probability of breakdown. Since more complete knowledge of the switching-surge strength of air is desirable, the ratio of impulse to switching may be increased to 100/85, again with a view to reducing risk at the expense of further compounding the overall factor of safety in design. It may be also noted that rain affects sparkover possibly as much as 10% under heavy precipitation. The practical significance of this condition like all others must be weighed in terms of probability of simultaneous occurrence, i.e., maximum switching overvoltage, maximum insulator swing and heavy rain precipitation. In addition to these factors, some consideration may be given to the Ferranti effect on very long lines.

When a greater conservatism is the aim, clearances as much as 10% higher than those in Table III may be practicable. Still higher ones can hardly be justified.

Lightning . . . Overhead ground wires on high-voltage transmission lines are omitted frequently where the incidence of lightning is low and especially where ice combines with the overhead ground wire to become a hazard. This is the usual practice in the Northwest. There electrical clearances to tower are determined from switching overvoltage considerations.

Throughout the Eastern States and in Canada, overhead ground-wire protection remains the practice because of more severe lightning conditions and the effect of lightning on line performance. Analysis of this application shows that in most cases there is no justification for proportioning clearances to tower over the requirements for switching overvoltages.

Again, a 35-degree swing angle and switching overvoltages 2.5 times line-to-ground are the design criteria. Then the impulse strength of either a 16- or 18-unit insulator assembly is coordinated to the air clearances between conductor and tower up to a 20-degree swing angle. Transmission voltages of 288 and 345 kv normally would require these numbers of units (5½-in. spacing x 10-in. diameter) in insulator strings. For a line design whose clearances are proportioned up to switching overvoltages 2.75 or more times line-to-ground, coordination between the insulator string and the clearances to tower would extend to swing angles well beyond 20 degrees.

A severe lightning-current discharge (in excess of 50,000 amp) in a tower footing with high tower-footing resistance seldom occurs simultaneously with swing angles much greater than 20 degrees. Such coincidence is too rare to require greater clearances merely to improve performance of the line. Insulation levels are high enough and performance of line designs to lightning satisfactory enough for clearances from conductor to tower to be determined from switching-overvoltage considerations only. Such clearances satisfy lightning requirements, except where grounding conditions are unusually poor. This is a consideration where tower footing conditions are unusually poor and cannot be corrected economically, as on the 380-kv Swedish transmission line and in eastern Quebec.

(*Continued on page* 176)

Velocity (mph) During Each Year, 1912-1948, at 25 Places in the United States

18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Avg.
57	70	71	84	59	69	62	60	61	68	68	56	66	62	65	63	71	59	59	69	68	61	78	71	74	64	62	66	59	61	66	64.8
68	68	57	95	60	68	64	70	73	65	66	63	66	66	79	70	87	68	73	72	67	70	84	67	65	77	65	64	67	66	69	69.3
40	35	32	38	39	37	34	38	36	30	34	31	31	34	37	30	31	30	34	38	35	35	34	35	37	41	37	35	38	34	35	35.6
38	30	28	28	30	27	25	30	40	37	29	26	29	27	28	35	26	32	29	28	30	38	28	27	34	28	25	30	28	30	33	30.1
31	30	34	30	29	34	30	27	28	38	28	29	29	32	32	30	25	32	30	31	35	40	26	35	31	30	34	32	35	37	34	31.3
37	36	43	38	40	38	38	31	32	37	34	32	34	34	32	40	30	35	36	32	35	36	35	58	52	45	33	42	42	39	40	37.3
32	34	30	33	33	34	29	35	30	30	30	38	29	34	34	35	30	35	32	29	34	34	29	29	31	29	30	33	37	34	41	32.4
38	50	38	38	44	41	50	35	34	35	42	36	35	37	40	46	39	40	37	46	37	39	33	44	34	34	35	42	46	41	44	39.8
32	32	34	46	37	37	37	31	32	33	33	34	33	31	32	37	33	32	32	33	32	33	38	53	49	51	52	59	57	66	56	39.8
39	44	49	43	41	46	41	42	41	44	36	45	49	37	42	56	35	39	34	43	41	41	35	37	38	42	38	36	46	39	38	41.1
57	46	43	37	40	38	46	35	36	38	34	38	38	29	32	32	34	38	30	34	32	33	33	31	33	26	34	28	31	37	33	37.7
38	38	38	41	41	41	43	41	38	40	38	36	34	42	49	39	40	43	43	43	38	40	43	40	45	42	38	42	37	43	51	40.4
50	95	41	51	43	39	44	38	37	39	37	36	43	35	47	49	47	39	49	42	50	38	43	37	61	54	45	56	43	51	39	46.3
51	45	49	54	53	54	50	45	54	54	57	52	47	39	49	51	59	51	49	53	54	50	52	68	55	50	54	49	61	49	49	51.4
41	31	35	31	28	27	38	32	29	32	29	32	28	26	30	28	29	28	28	29	27	25	29	25	26	55	46	42	41	54	48	30.8
45	46	42	47	38	38	47	43	41	47	37	45	37	36	35	40	35	38	40	51	34	39	43	34	42	37	34	40	43	43	45	40.0
41	32	31	38	35	36	30	31	32	32	33	31	37	31	38	40	34	42	40	38	36	35	36	30	34	41	41	47	45	43	40	34.7
43	47	37	46	43	40	44	38	43	41	38	45	42	42	47	41	37	43	38	43	38	42	47	37	44	38	47	42	45	50	42	41.9
49	47	46	54	43	49	43	62	39	39	47	48	36	38	39	39	38	39	44	35	38	39	35	40	38	42	32	34	39	34	35	42.5
44	47	49	49	44	53	40	46	47	43	50	43	43	40	42	41	42	43	43	44	47	38	43	38	41	41	40	42	42	43	46	43.6
52	56	48	39	57	46	46	51	38	50	45	50	48	52	42	46	51	48	46	46	45	47	45	49	46	42	51	55	44	52	48	48.5
54	54	56	56	56	47	60	56	56	59	54	52	54	51	59	60	57	62	58	47	82	56	50	52	57	70	82	63	57	67	57	58.4
47	36	34	32	37	36	37	38	41	37	42	38	45	37	38	46	39	34	38	34	38	33	32	35	44	46	43	34	32	41	38	38.9
38	41	32	35	43	35	38	38	43	40	55	36	40	35	40	51	53	47	40	34	43	37	66	33	44	33	60	57	43	45	34	42.8
40	84	40	38	41	40	51	41	49	44	37	61	34	46	40	43	32	46	38	43	33	33	42	40	35	40	56	40	35	54	73	43.4

al of the Franklin Institute, July 1955, p 49

3-Phase Serves Big, 1-Phase Small

Policy adopted by Chattanooga Electric Power Board after study of test areas proves

GEORGE R. PARKER, *Chief Engineer, Electric Power Board of Chattanooga, Chattanooga, Tenn.*

The Electric Power Board of Chattanooga has established a policy of supplying 3-phase service for residential air conditioning units of five tons and larger and single-phase service for the smaller sizes. The policy also provides for encouragement of the use of 230-v equipment for units larger than ½ hp.

This policy was set up after careful consideration of the advantages and disadvantages of single-phase and 3-phase service to both the customer and the utility. From the customer viewpoint equipment costs and maintenance costs are lower with 3-phase motors. Wiring costs in general are higher. An analysis showed that from the customer viewpoint, the combined equipment and wiring costs are lower for single phase in sizes up to five tons and lower for 3 phase for units larger than five tons. For the five-ton unit additional wiring costs are about equal to the saving in equipment costs. Rewiring for smaller units costs $55 to $90 more than the equipment saving.

From the utility viewpoint it costs more to provide 3-phase service than it does to provide single-phase service. The analysis showed that revenues from units of five tons and larger justified this additional expense while revenue from the smaller units did not justify the additional expense. Therefore, the new policy seemed logical when both customer and utility interests were considered.

Some consideration was given to subsidizing customer installation expense on small single-phase units. The customer would be saved the cost of rewiring, and we would save the costs of providing 3-phase service. The idea was to encourage this load as the system peak is in winter because of electric house heating. However, it appeared that the promotional value would not be great as the subsidy would be small in proportion to the total cost. Also, recent growth in air conditioning load indicated that the promotion probably was not needed at this time.

Some consideration was given to a plan which would have the customer pay a facilities charge if 3-phase service were wanted for the smaller units. This idea was discarded because an estimate would have to be made for each installation before the customer would know what he would have to pay. This would be time consuming and would be unsatisfactory to both the customer and the dealer. A flat charge would have to be based on averages that would probably be more than the customer would save on equipment, and he would, therefore, be unwilling to pay it.

Load Attractive If . . . Attention was focused on this problem by the rapid growth of residential air conditioning loads in the past two or three years. This growth raised several questions, such as:

1. Is it a desirable load?
2. What will it amount to?
3. How should it be served?
4. What will be its financial effect?

Chattanooga's substantial saturation of electric house heating has produced a load curve with a high peak in the winter. This is increasing as the house heating load increases.

To answer the questions raised, we had to estimate the potential air conditioning load. In arriving at the potentialities of residential air conditioning some guessing and a considerable amount of study were required. An effort was made to establish a relationship between electric heating load and air conditioning load as saturation of residential electric heating was ample for study purposes. This was difficult because heat producing appliances add to the air conditioning load but decrease the house heating load.

An estimate of 60% of the Btu requirements for heating has proved to be a reasonably accurate estimate of refrigeration required for the group. On this basis it was estimated that most houses would require from two to three tons of air conditioning. A ton of refrigeration of this type requires one horsepower of compressor capacity and in this area uses about 1,200 kwhr per season.

If the average installation is taken at 2½ tons, the air conditioning equipment will add 3,000 kwhr for

Distribution Costs More Per Customer . . .

3-Ph Custs./ Transf. Sta.	Cost Increase at 4 kv	Cost Increase at 12 kv
1	$220	$425
2	150	235
3	130	180

And Wiring Costs Are Higher . . .

Size Unit	3-Ph Equipment Saves	3-Ph Wiring Boosts Cost (Existing Homes)	3-Ph Boosts Cust. Cost
2 ton	$60	$150	$90
3 ton	95	150	55
5 ton	158	175	17

Air Conditioners

satisfactory to utility and customers

Data for a Typical Installation

Unit size	2½ tons
Kwhr per ton per season	1,200
Kwhr per unit per season	3,000
Additional kwhr used by cool comfortable home	500
Average kwhr per room cooler per season	1,000
Estimated saturation in few years	30%
Kwhr increase per home at 30% saturation	550

each installation. Extra kwhr consumed as a result of a cool, comfortable home could easily bring the total additional consumption for a completely air-conditioned home to 3,500 kwhr or 1,400 kwhr per ton. The average consumption for room-coolers is approximately 1,000 kwhr per unit per season.

Willingness of people to pay for comfort has already been demonstrated by the acceptance of electric house heating. In view of this we believe that a 30% saturation of air conditioning can be expected on Chattanooga in a few years. Assuming that this 30% saturation is split 20 and 10 between room coolers and complete systems, the average residential consumption will be increased 550 kwhr per year. Based on the number of customers on the Chattanooga system, this would add 35 million kwhr per year to residential sales, increase revenue by nearly $250,000, and bring average annual use up to over 7,500 kwhr. Therefore, this load is very attractive provided the cost of serving does not exceed the investment which the revenue will support.

If the load is served single phase, the system will have to spend very little because facilities will generally be adequate, especially if the customer has house heating or if there is a house heating customer on the transformer from which he is served. If 3-phase service is provided, phase wires will have to be strung, transformers added, services and meters changed.

Study Two Areas . . . To determine the cost of 3-phase service in residential sections of Chattanooga, two areas were studied, one served at 4 kv and the other at 12 kv. Each had approximately 300 customers. The cost of serving every tenth customer with 3 phase was estimated. This cost was higher in the 12-kv area. While surprising, this is explained by the longer single-phase taps where the higher voltage is used, the additional work involved in replacing ridge pins with crossarms, the necessity in most cases of replacing the transformer pole with one five feet higher and rebuilding the transformer station.

Estimated average cost per customer in the 4 kv area was $220. This figure was reached after giving credit for the capitalized value of the reduction in losses brought about by the additional primary copper. This estimate provided for adding to an existing transformer, a 3-kva transformer for each customer. If two customers are served from each station and a 5-kva transformer used, the cost per customer is $150. For three customers per station using a 10-kva transformer, the cost is $130.

Comparable figures for the 12-kv area are $425 for one customer per station, $235 for two, and $180 for three. In all cases, the estimates include present day costs for the small transformers. The power board has on hand a number of these units in the 2,400-v class that will be junked if some use is not found for them. However, if there were many such installations, there would not be enough of the small transformers. Even if a sufficient number were available at no cost, the results would change very little as the carrying charge would be reduced only by the interest component applied to the value of the transformer as depreciation, taxes, and maintenance would continue to run.

Customer Viewpoint . . . The customer would save on both the first cost of his equipment and the motor maintenance if 3-phase service were provided. This would be offset to some extent by the cost of his wiring. The difference between the cost of 3-phase and single-phase equipment is about $60 for a two-ton unit, $95 for three tons, and $158 for the five-ton size. If the equipment is to be installed in an existing house, 3-phase wiring will cost approximately $150 for two or three-ton units, and about $175 for a five-ton unit. If it is a new house, there will be very little difference in wiring cost; and if considerable heating is involved, as is true in many Chattanooga homes, 3-phase wiring may be cheaper.

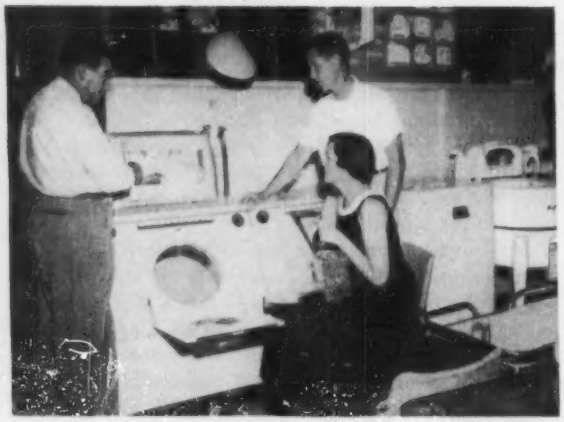
The increased maintenance costs for single phase over 3 phase is rather hard to determine. Everyone agrees that it costs more for the maintenance of a single-phase motor. How much more seems difficult to determine. We assumed that the maintenance and replacement cost of a single-phase motor was double that for 3 phase and that it would be equal to the cost of buying a new motor at the end of ten years. We used the U. S. government saving bond interest rate to arive at a figure for the present worth for excess maintenance of single-phase motors. The figures reached were: $173 for 2-hp, $220 for 3-hp, and $488 for 5-hp motors. These figures indicate that 3-phase equipment will save the customer overall $83 for 2-hp, $165 for 3-hp and $349 for 5-hp units.

In order for the customer to realize these savings, we would have to spend the money necessary to provide 3-phase service. Assuming that an average of two units will be served from each 3-phase bank and that they will divide evenly between the 4 and 12-kv areas, the average cost to provide service would be $193 per customer. With the average estimated 3,500 kwhr use per year, the revenue will not support this added investment. The additional revenue for units five tons and larger supports the additional investment, and, therefore, may be served 3 phase.

This policy of serving customers having large-size air conditioners at 3 phase and those having smaller size at single phase has worked out satisfactorily.

It's Called RAPP with WOMA—

SALES REPRESENTATIVE explains details of new merchandising plan to the appliance dealer. He may become authorized RAPP dealer



UTILITY EMPLOYEE selects the appliance he needs from RAPP dealer. Employee gets 10% WOMA credit and five prospect cards

DEALER POINTS OUT the most valuable features of the new appliance. Employee will talk these up when showing unit to his friends

THE MISSING LINK to an appliance sale sometimes is wiring or plumbing. Reddy Hook-up Plan provides modernization loans

A stranger in Phoenix might take "RAPP with WOMA" and "The Missing Link" to mean that some of the local power company people have had too much of the noonday sun. But to Arizona Public Service Co the phrases are the magic words that stand for a new idea in appliance merchandising. And the new idea promises benefits to the company, its employees, and local appliance dealers.

The Reddy Appliance Purchase Plan (RAPP) is Public Service's way of getting load-building appliances into its employees' homes. The plan is unique in that it channels merchandise through the appliance dealer and not the distributor. Word of Mouth Advertising (WOMA) is the employee follow-up designed to build more load for Public Service and more sales for dealers. By WOMA the employee sells his neighbors on the advantages and convenience of owning more appliances. And the "The Missing Link," also known as the Reddy Hook-up Plan, is a scheme offering convenient financing to Public Service's customers for the installation of appliances, modernization of wiring, or addition of plumbing associated with the installation of an appliance.

How RAPP with WOMA Works . . . Here is how the RAPP with WOMA plan deals out the three-way benefits. An employee selects any appliance from any RAPP dealer. The dealer after checking the employee's company identification card, completes a WOMA promotional offer form that gives the employee a 10% credit on the retail price of the appliance.

The form is taken to the employee's supervisor, who checks his credit and recent purchase of other appliances.

and the Missing Link

CREDIT RATING of employee is checked by his supervisor. No-cost financing and monthly repayment terms are available to the employee

A NEW SALE is started after the prospect card is turned in by the employee who bought his appliance from local authorized RAPP dealer

Appliance merchandising plan provides three-way benefits:

Arizona Public Service Co

1. Adds load.
2. Improves dealers goodwill.
3. Raises employee morale.

The employee

1. Gets eligibility for promotional offer.
2. Needs only 10% down payment.
3. Pays no financing charges.

The appliance dealer

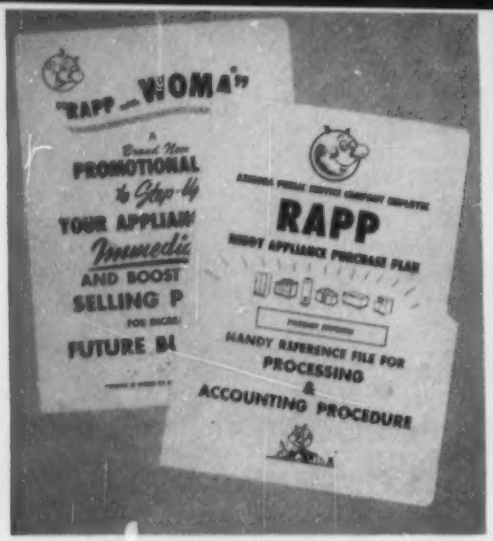
1. Sells for cash.
2. Gets more business from company employees.
3. Obtains prospects with each sale.

If his credit rating is satisfactory, the employee completes a purchase request order. By signing the order, he agrees to buy only for his own family use, to refrain from discussing the special promotional offer, and not to resell the appliance within five years. The agreement also provides another 10% credit toward purchase.

The completed order is sent to the dealer. He delivers and installs the appliance and bills Public Service. The employee receives a sales order receipt that lists repayment terms, retail quoting price, and the final promotional price. Employees may buy for cash and get another 2% credit. They may choose terms of 30-days charge or monthly payments up to 24. A 10% down-payment is required on all term purchases, but there are no carrying or interest charges on the balance after down payment.

After the appliance has been installed, WOMA enters the picture. As part of the promotional offer, the employee gets five prospect cards from the dealer. These are to be returned to the dealer with the names and some information about those who have seen the new appliance demonstrated in the employee's home. The employee is cautioned not to disclose the credits that were made available to him. He is urged to quote only the full list price during the demonstration.

The Reddy Hook-up Plan is designed to save sales that might be lost because of inadequate wiring or plumbing—the missing link. The plan is available to any residential customer of Public Service who has a wiring or plumbing job costing less than $200. In the case of renters, financing may be completed through the owner. Appliance dealers who need demonstration equipment in-



PROCEDURE FOLDERS for dealers and supervisors explain the rules Arizona PS employees must follow under the plan

EMPLOYEE BROCHURE is attractively printed in black and red. It gives information employee must know about RAPP, warns not to reveal credit allowances

stalled in their stores also are eligible.

Reddy Hook-up financing works in this way. The customer selects his own dealer or contractor who plans the job and estimates the cost. Then the customer fills out an application for credit with Public Service. The company completes the contract and note upon approval of the customer's credit.

Utility Pays the Contractor . . . After the work has been completed, the contractor endorses the note and sends it to the company with his invoice and inspectors' approval slips. After the work has been checked and inspected by the company, the contractor is paid in cash. The customer is billed monthly on a form separate from his utility bill. Otherwise, says Public Service, the customer might forget about the monthly bill and wonder why his utility bill is so high.

There is no down payment required by Public Service under Reddy Hook-up. Repayment periods are six months for loans from $10 to $50; 12 for $50 to $75; 18 for $75 to $125; and 24 for $125 to $200. Monthly payments include interest at 4%.

Prior to adoption of RAPP, Public Service dealt directly with distributors in the handling of appliances for its employees at prices less than retail. And paralleling the experience of most utilities that operate such an employee purchase plan, there were several undesirable aspects to this scheme.

To overcome them, while at the same time meeting the objectives of building load, maintaining employee morale, and increasing dealer goodwill, the general sales staff attacked the problem. It was determined that some program should be worked out whereby employees could buy appliances directly from retail dealers.

Contact Dealers and Employees . . . Before RAPP with WOMA could get underway, it was necessary to contact all the dealers and company employees. Rather than try to sell the plan to dealers at group meetings, it was decided to make individual calls. Company sales representatives visited each dealer. They explained the purchase plan and the advertising follow-up in detail, using the dealer file folder especially prepared for this purpose. In selling the plan, it was considered most important that the program not appear to be an indorsesent of discount selling by retail dealers.

The selling copy on the inside front cover and first three pages of the dealer folder quite vividly point up the advantages of the purchase plan to the dealer. Nowhere is mention made of a discount. It was frankly stated that the company hoped to work with the dealers in a plan such as RAPP, rather than engage in direct merchandising to sell appliances to its employees, or arrange with distributors or factory representatives to make special prices available to employees. Through RAPP the dealer could realize a profit from employee appliance purchases. Furthermore, the employee would boost the dealer and his merchandise through home demonstrations.

WOMA is emphasized in the dealer folder. Dealers were told they would be paid in cash, either by the employee or through the company. They would not be expected to accept trade-ins but could do so at their own option. And the dealer would be expected to demonstrate, deliver, install, and provide service for the appliance bought by the employee, just the same as for any other customer. Finally, the forms to be used under RAPP and how to fill them out, employee identification, and how to bill the company were explained. Dealers were not forced to join in the program. After the sales representative had presented the facts, it was the dealer's decision whether to participate. Each dealer who said yes was requested to complete a form indicating that he wished to become an authorized RAPP dealer.

Bought 552 Units . . . The program started last Sept. 1. In the first five months, Public Service employees purchased 552 major appliances for a total retail value of $144,000. Actual cost to the company was $13,000 for this period against an estimated cost of $20,000. It is expected that buying by employees will slow down as they get their homes equipped with the latest appliances. The heaviest buying occurred in the company divisions in which employee purchase plans were not available before. More than 400 dealers have signed up as RAPP dealers. They all are listed for reference by employees, along with the makes of major appliances each dealer carries.

WASHINGTON COMMENT

JESSE MOCK

FIGHT ENDS: As Sen John Sherman Cooper (R.-Ky.) looks on, REA Administrator Ancher Nelsen approves agreement integrating systems of Kentucky Utilities and REA-financed East Kentucky Rural Electric Cooperative

Republican rural electrification policies have survived an acid test in eastern Kentucky—introducing techniques that are sure to be used in other troublesome areas.

Republicans Try New Techniques With the Co-ops

Application of these policies has brought to an end the bitter legal feud that has raged between electric companies and the federated rural electric cooperative in eastern Kentucky for nearly four years. Rural Electrification Administrator Ancher Nelsen, who recently approved the formal agreement ending hostilities, has a right to be proud.

The center of the Kentucky dispute was whether East Kentucky Rural Electric Cooperative should build a vast transmission system and generating facilities which partially duplicated electric company facilities. A loan for initiation of these facilities was approved way back in 1941 by REA.

Long, Complex Battle . . . A legal battle over this proposed construction was begun in 1950 when electric companies in the area contested a Public Service Commission order certifying the co-op program. This was fought back and forth from 1950 until the middle of last year, becoming so complicated that only attorneys intimately associated with the case were able to interpret the legal situation.

It was at this point that the Republican chieftians at REA stepped into the picture with new ideas and a new philosophy. Their fundamental policy was to substitute a spirit of cooperation for the bitter judicial squabble that appeared to be endless.

As a first step, Nelsen hired an independent engineer to confer with the cooperative and with the electric companies in an effort to reach some agreement on the technical requirements of individual distribution cooperatives. There are 19 such co-ops in the East Kentucky generating and transmission cooperative.

The job took months, but served to center the attention of the two groups on the technical problems involved. Around a conference table tempers were calmer than in a court room, and separate problems took on the aspects of mutual problems.

By March of this year the co-op and the electric companies had reached agreement on a portion of the co-op program, and were able to bring an undisputed petition to the state PSC for clearance. This enabled the co-op to go ahead with a part of its transmission system and its generation facilities.

Systems Integrated . . . Further negotiation produced the agreement approved recently by Nelson. It appears to be fairly comprehensive, providing for integration of the co-op system with the largest privately owned electric utility in the area, Kentucky Utilities Co.

He cited these three advantages of the integration plan:

- It will eliminate costly duplication of transmission facilities for both systems, making it possible for the co-op to reduce its proposed investment by some $3 million.
- Both systems will benefit through assurance of a more adequate and dependable supply of power.
- Wholesale power rates to the 19 distribution cooperatives who own East Kentucky Rural Electric Cooperative will be reduced below present rates.

It was clear that Nelsen hoped the Kentucky agreement would set a pattern for settling such disputes in other areas. He called it "an example of what can be done when producers of electric power sit down around the conference table and try to work out a practical power plan for the future."

In the future REA will encourage the same sort of techniques to settle such controversies. It will likely recommend that co-ops hire their own engineers to help solve their problems, but REA will be standing by if called on.

A similar, but more heated, controversy is now receiving this kind of treatment in Missouri. While legal proceedings continue, engineers of co-ops and electric companies are trying to work out solutions which will endure long after the court decisions are forgotten.

TECHNICAL NOTES

ARCHER E. KNOWLTON

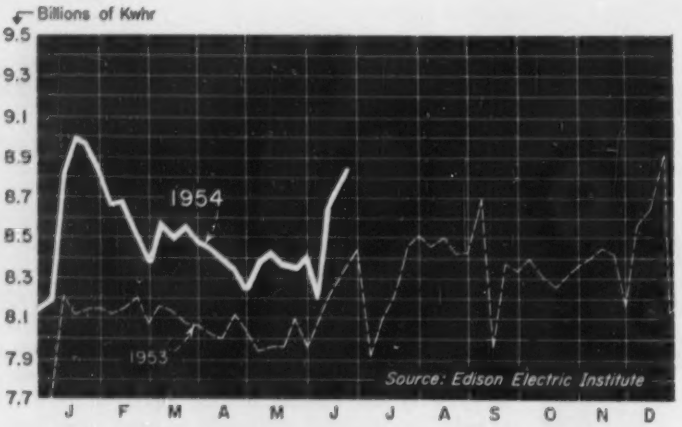
Reflecting paint will usually not materially reduce internal temperatures of electrical apparatus because it keeps in the heat from internal losses even though it keeps much of the radiated energy out.

Station start-ups without mishaps and delays happen when everything has been checked and double-checked—breaker settings, meters, instruments, controls, relays, design departures, etc., etc.

Plant floors can be cleaned by water and detergents carried in a cart, applied with a mop, and removed by a squeegee attached to a vacuum cleaner.

Beryllium could be a more useful metal if an alloy could be found to improve the ductility.

STATISTICS



Output Week Ended June 19—8,850,000,000 Kwhr

Seasonally Adjusted Index†—176.2

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
June 19	+6.3	+0.5	+1.0	+0.9	+7.5	+18.5	+2.9	+7.3	+9.6	+8.0
June 12	+5.0	+0.6	−0.8	−1.9	+5.0	+17.1	+1.1	+9.7	+9.4	+11.1
June 5	+1.9	−3.5	−4.4	−7.9	+2.9	+16.7	+1.7	+6.8	+4.5	+7.5

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load ‡(Million Kw)	Apr.	73.7	74.7	70.2
Capacity (Million Kw)	Apr.	93.56	92.99	83.84
Production (Billion Kwhr)	Apr.	36.84	38.92	35.63
Hydro	Apr.	9.91	9.92	9.70
Fuel	Apr.	26.93	29.00	25.92
Fuel Consumption				
Coal (Million Tons)	Apr.	8.68	9.89	8.91
Oil (Million Barrels)	Apr.	4.78	6.46	7.15
Gas (Billion Cu Ft)	Apr.	91.10	78.23	76.58
Sales (Billion Kwhr)	Apr.	32.31	32.53	31.75
Residential	Apr.	9.93	10.15	8.86
Commercial	Apr.	5.62	5.60	5.15
Industrial	Apr.	14.60	14.67	15.46
Other	Apr.	2.17	2.10	2.28
Net Income Class A & B Companies ($ Million)	Apr.	96.05	94.29	87.29
Estimated Dec. '54 Peak ‡(Million Kw)	Apr.	88.4	88.5	92.1
Kwhr per Residential Customer (12 Month Average)	Mar.	2,398	2,382	2,211
Revenue per Kwhr Residential Service (12 Month Average)	Mar.	2.72¢	2.73¢	2.76¢
Canadian Production (Billion Kwhr)	Mar.	5.77	5.15	5.78

Business Statistics

FRB Industrial Production Index†	May	123*	123	136
Gross National Product Annual Rate ($ Billion)	1stQtr.	357.8	363.5	363:9
EW 4 Industry Production Index†	Apr.	115.1	116.7	126.5
ENR Construction Cost Index††	May	129.7	129.0	123.5
BLS Consumer's Price Index	May	115.0	114.6	114.0
NEMA Insulation Materials Sales Index†	Apr.	124	136	189
NEMA Electric Appliance Sales Index†	Apr.	96	105	118
NEMA Household Refrig. Sales Index†	Apr.	73	89	96
Metal Prices (June 22)				
Copper, Conn., V., lb		$.30	.29¾	.29¾
Lead, N. Y., lb		.14	.14	.13½
Zinc, prime Western S. St. Louis, lb		.11	.11	.11
Tin, Straits, qual. N. Y. lb		.93½	.93¾	.91¾
Aluminum, ingot, base price		.21½	.21½	.20½
Nickel, base price		.60	.60	.60
Steel, billets, Pitts., ton		62.00	62.00	59.00
Steel, scrap, No. 1 heavy, Pitts., ton		29.00	30.00	39.00

*Preliminary **Revised ‡Class I Systems †1947-49=100 ††1949=100

Bureau of Rec Records Power Progress in 1953

During the 1953 fiscal year, the Bureau of Reclamation spent over $203 million in construction activities throughout the west and in Alaska. The Annual Report of the agency translates that money in part to 3,700,000 acre-feet of storage capacity in new reclamation project reservoirs, 240,000 kw of electric generating capacity, 700 miles of canals, pipelines, and laterals, and 1,938 miles of large electrical transmission lines completed during the year.

Dams constructed . . . One of the major projects put in operation was the Hungry Horse Dam in Montana, an achievement the Bureau accomplished nearly one year ahead of schedule.

At the Grand Coulee pumping plant, two additional units were installed, bringing that project to its full presently scheduled capacity. Incidentally, the Grand Coulee power plant set a world's record for a single hour's generation when a total of 2,309,000 kwhr was recorded on August 16, 1952. The Dam itself provided about 40% of all hydroelectric energy used in the Pacific Northwest in 1953.

In addition to the construction activity under way or completed, Congress further authorized construction on 10 new projects in the west, seven of which are dams.

Capacity Added . . . The combined capacity of the 26 power plants built and operated by the Bureau totalled 4,421,200 kw as of June 30, 1953. This was an increase of 240,000 kw or 5.7% over 1952. Capacity added at the Boulder Canyon project totalled 82,500 kw, at the Missouri Basin project, 15,000 kw, while the Hungry Horse project provided the bulk of the increase with 142,500 kw.

At the end of June 1953, the Bureau had 14 new power plants under construction which will have an ultimate installed capacity of 525,800 kw (nameplate). An additional 28 plants were authorized at that time with a potential of 1,023,300 kw.

The Bureau's sales of energy during the fiscal year totalled 25,850,471,408 kwhr with total revenues from sales approaching $45 million.

FINANCIAL

Adequate Rates Needed...

. . . if utilities are to serve the public properly, Robert Quig of Ebasco Services tells Canadian Electrical Association

Utilities have to serve the public, but they also have to have rates high enough to produce adequate revenue, Robert S. Quig, assistant manager, Rate Department, Ebasco Services, Inc, told the Canadian Electrical Association at Murray Bay, Que.

"Without adequate earnings," he said, "reliable and expanding service cannot be given to the customer, the owner's property cannot be maintained, new capital needed for service growth will not be readily forthcoming, the investor or the general taxpayer will be penalized, and everyone, in the final analysis, will be the loser."

Quig, in pointing out that "adequate utility pricing requires more than technical knowledge," said, "We need not only technical engineering knowledge but also a comprehensive understanding of the economic, social and political aspects of our business. We deal with people on a mass market basis."

In discussing the importance of U. S. Supreme Court ruling on regulatory policy, Quig reminded his audience of the Bluefield Decision which said in part, "A public utility is entitled to such rates . . . (that will) enable it to raise the money necessary for the proper discharge of its public duties."

The need of objective policies in guiding management decisions was expressed by Quig in the statement that "rates carry company policies to customer." He said, "Public utility rates and pricing are the media through which every utility company is brought into the homes of our customers—yes, into the pocketbook of every household . . . Never in the history of human accomplishment have people obtained so much for so little as they do in their utility service."

Quig continued by saying, "Most of the benefits of the value of the service and the 'progress of the art' have been handed to the consuming public. I do not think that there is an adequate public understanding or appreciation of this fact . . . We need to inform legislators, regulators, businessmen and our customers of the importance to all of a strong utility."

Warns Against Complacency . . . Quig warned his audience about the future of the electric utility industry, if earnings were inadequate, by pointing out that, "Many utility managements may feel that, generally speaking, their pricing is in reasonably good shape . . . This same feeling of complacency also existed with respect to many of our operations which are now but a dim memory. In the utility field we have seen the passing of the interurban railway and we are all aware of the plight of most of the transit lines which eke out a precarious existence in the metropolitan areas of Canada and the United States. While many factors are responsible for the business problems of these enterprises, I believe that any list of these factors would include: lack of attention to service, failure to plan ahead and anticipate changes, inadequacy of earnings generally, understatement of depreciation expense, and a regulatory climate which for the most part felt that the best service that could be given to the general public was to keep the price for that service at a 'barebones existence' level."

With respect to the value of service, the speaker said, "With current-consuming appliances in the home, nightly television entertainment, the refrigeration of food, the heating and cooling of the house, (etc.,) . . . the value to the customer of every additional kilowatthour sold has imposed standards of reliability of service and quality of service undreamed of ten or fifteen years ago. All this has cost money. The heavy investment in what is essentially the buttressing of the customer against a possible failure in service continuity has cost the electric utilities millions of dollars, without a commensurate return. From a value point of view, the end kilowatthours in any rate structure could be priced higher than the initial ones since it is these kilowatthours which supply more valuable portions of the customer's service."

Quig made it clear that pricing of the service and public relations are intimately connected. He said, "When one deals with the question of rates, one unavoidably enters the highest levels of corporate policy, since rates not only produce revenues and earnings but also touch on the field of public relations in a powerful and persuasive manner."

Cost Allocation . . . A considerable amount of time and attention has been given by many people in the industry to the problem of customer cost allocation and by the commissions to the cost accounting approach as a method of setting rates. On this subject Quig said, "Naturally, we need to know all we can about our business, the characteristics of our ever-changing loads and their impact on costs. Continuing analyses of these ever-changing costs, both capital and operating, can be a very helpful tool in assisting managements in their policy decisions. The design of rates, however, cannot be based solely on costs."

In discussing the "economic facts of life," the speaker mentioned economic depreciation and the pioneering efforts of American Telephone & Telegraph Co system to get regulatory recognition in the making of rates.

The Ebasco Services' rate official stated, "By economic depreciation we mean giving effect in our rates and prices to the expense of property consumed in providing service to the public on a current or present-day cost basis, rather than on the much lower historical cost. We, as rate people, cannot be blind to it in our pricing policies."

A very important point was made by Quig when he said that, "an adequate rate of return must recognize more than the mere cost of capital." He continued—"The history of our regulation is replete with instances where commissions, in setting the rate of return, gave utilities nothing more than the bare cost of capital. Other cases can be cited where commissions, being more circumspect and knowing that they had to find a rate of return rather than cost of money in order to

'get under the wire', hewed closely to the letter of the law by finding first the historical cost of capital (as one would expect) and then adding a nominal increment which was then called the rate of return."

Quotes EW . . . As to the overall question of the rate of return, Quig quoted a recent editorial by The Electrical World which said, in part, "The attraction of capital theory to which many commissions adhere also ignores the requirement for fairness to the past investor. The very concept of a fair return can in fact apply only to the past investor because new investors are in a position to dictate the terms on which they are willing to put their money into a utility enterprise. As the result of the inflation since 1940, capital which is attracted supplies only a fraction of the buying power of capital invested at earlier price levels. Yet many commissions settle on the cost of money approach which aims at maintaining only the book value of the existing equity without consideration for the greater value, in terms of current dollars, which this investment represents."

Another point made by the speaker was that, from an economic point of view, regulation is not a substitute for competition. Quig said, "It is generally recognized that regulation is a substitute for competition in the public service field. Although competition may control the level of gross revenues, utility regulation as it has been practiced controls the level of net income. Thus, the similarity between the two is more apparent than real. If regulation were a true substitute for competition, electric utility rates would be set at the level of reasonableness to the consumer rather than at some arbitrary level which will just attract the new investor who, today, is usually the large institutional investor."

No Substitute . . . In conclusion, the speaker made the point that regulation is not a substitute for management. He made the point that ". . . a public utility should be reasonably regulated no one will deny, but, as the U. S. Supreme Court said in 1923, in the Southwestern Bell Telephone case, 'It must never be forgotten that while the state may regulate, with a view of enforcing reasonable rates and charges, it is not the owner of the property

(*Continued on page* 172)

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
June 17	**2.89**	**2.95**	**3.16**	**4.03**	**4.15**	**4.51**	**4.75**	**5.05**	**5.45**
June 10	2.89	2.96	3.17	4.07	4.18	4.49	4.78	5.11	5.57
END OF QTR									
1st 1954	2.82	2.87	3.14	3.88	4.09	4.42	4.83	5.19	5.42
4th 1953	3.07	3.12	3.34	4.17	4.32	4.62	5.07	5.57	5.51
3rd 1953	3.30	3.33	3.54	4.35	4.52	4.83	5.36	5.97	6.01
2nd 1953	3.34	3.46	3.64	4.47	4.70	4.88	5.52	5.93	6.10

Data: Reis & Chandler, Inc.

EARNINGS

Company	Period Months	Ended	Net Income 1953	Net Income 1952	Earnings Per Common Share 1953	Earnings Per Common Share 1952
City of Winnipeg Hydro Electric System	12	Dec.	$716,225	$916,219	$....	$....
Maine Public Service	12	Dec.	467,504	414,971	1.64(a)	1.66(a)

Notes—Figures shown for the two companies have been audited; (a) Based on 245,000 shares in 1953 and 210,000 shares in 1952.

FINANCIAL

Company and Description	Amount of Offering (000)	Offering Price	Yield to Public
WEEK OF JUNE 17-23			
Bonds			
Central Vermont Public Service—1st mtg 3¼% due 1984	$4,000	100.959%	3.20%
Gulf Power—1st mtg 3¼% due 1984	10,000	102.625	3.115
Preferred Stock			
Connecticut Light & Power—200,000 sh $2.06 $50 par	$10,000	$50.00	4.12
Pacific Gas & Electric—1,000,000 sh 4.50% $25 par cum	25,000	25.75	4.37
Duquesne Light—120,000 sh 4.10% $50 par	6,000	51.25	4.00
SCHEDULE FOR JUNE—JULY—AUGUST			
Bonds			**Bid Date**
Consumers Power—1st mtg due 1984	$25,000	.....	June 24
Duquesne Light—1st mtg due 1984	16,000	.....	June 29
Southwestern Public Service—1st mtg due 1979	20,000	.....	July 8
Boston Edison—1st mtg due 1984	18,000	.....	July 26
Metropolitan Edison—1st mtg due 1984	3,000	.....	Aug. 15
Arkansas Power & Light—1st mtg due 1984	7,500	.....	Aug. 24
Gulf States Utilities—1st mtg due 1984	24,000	.....	.....(e)
Consolidated Edison Co of N. Y.—1st mtg due 1984	50,000	.....	.....(e)
Preferred Stock			
Maine Public Service—40,000 sh $50 par cum	$2,000	.....	June 24(h)
Public Service Co of Indiana—600,000 sh $25 par cum	15,000	.....	June 29(f)
Florida Power & Light—50,000 sh $100 par	5,000	.....	June 30
Public Service Co of New Hampshire—about 75,000 sh	7,500	.....	.....
California Electric Power—105,000 sh $50 par	5,250	.....	.....(b)
Missouri Public Service—50,000 sh $100 par	5,000	.....	.....(a)
Southern Utah Power—3,244 sh 5% $100 par (1,224 sh to be exchanged for a like amount of 4½% now outstanding and balance of 2,000 sh to be sold privately)	322	.....	.....
Central Vermont Public Service—10,000 sh $100 par 4.65%	1,000	.....	.....(c)
Gulf States Utilities—160,000 sh $100 par	16,000	.....	.....(e)
Southwestern Public Service—80,000 sh $25 par cum	20,000	.....	.....
Common Stock			
Long Island Lighting—690,062 sh (to be offered commonholders on 1-for-8 basis, record July 7; unsubscribed sh to be sold to underwriters; 64,685 sh to be offered to employees)	.....	.....	.....
Florida Power & Light—245,000 sh	.....	.....	June 30
UNSCHEDULED, AND/OR UNDER CONSIDERATION			
Bonds			
Indiana & Michigan Electric—1st mtg	$16,500	.....	.....
Long Island Lighting—1st mtg	20,000	.....	.....
Kansas City Power & Light—1st mtg	16,000	.....	.....
Missouri Power & Light—1st mtg	7,500	.....	.....
Central Hudson Gas & Electric—1st mtg	10,000	.....	.....
Connecticut Light & Power—1st mtg	10,000	.....	.....
Central Illinois Electric & Gas—1st mtg	4,000	.....	.....
New Orleans Public Service—1st mtg	6,000	.....	.....
Preferred Stock			
Virginia Electric & Power—600,000 sh	.....	.....	.....
Central Hudson Gas & Electric—80,000 sh	.....	.....	.....
Common Stock			
New England Electric System—910,883 sh (to be offered commonholders on 1-for-10 basis)	.....	.....	.....

Notes—(a) Postponed indefinitely; Kidder, Peabody & Co, underwriters; (b) Temporarily postponed; Merrill, Lynch, Pierce, Fenner & Beane group, underwriters; (c) To be sold privately; (e) Temporarily postponed; (f) To be negotiated; and (h) Merrill, Lynch, Pierce, Fenner & Beane, and Kidder Peabody & Co, underwriters.

G.E. designs light, compact, 5 KV current transformer with high resistance to corrosion

One third smaller and lighter, the new butyl-molded, outdoor, Type JKW-3 transformer is easier to install and maintain.

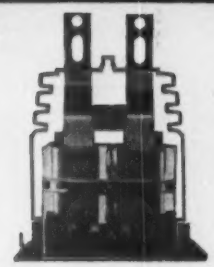
Almost completely corrosion-proof, this new General Electric current transformer is the first butyl-molded transformer designed for 5000-volt outdoor application. This revolutionary design has virtually eliminated maintenance. **CORROSION-RESISTANT** materials are used in all exposed metal parts. The case and primary bushing are butyl rubber. The butyl also serves as insulation and as an important factor in the new Type JKW-3's high mechanical strength.

EASIER TO INSTALL, this new G-E current transformer can be mounted in any position for bottom-, side-, or top-connected installations. The lightweight and smaller size facilitates installation and handling.

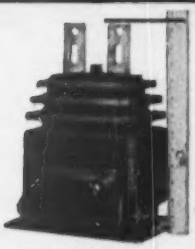
ACCURACY CLASSIFICATION of the Type JKW-3 transformer is 0.3 at burdens: B-0.1 to B-2.0. Ratings are from 10 to 800 amperes.

FOR MORE INFORMATION, contact your nearest G-E Apparatus representative, or write for Bulletin GEC-1222 to: Section 604-40, General Electric, Schenectady 5, N. Y.

GENERAL ELECTRIC



1 BUTYL-MOLDED

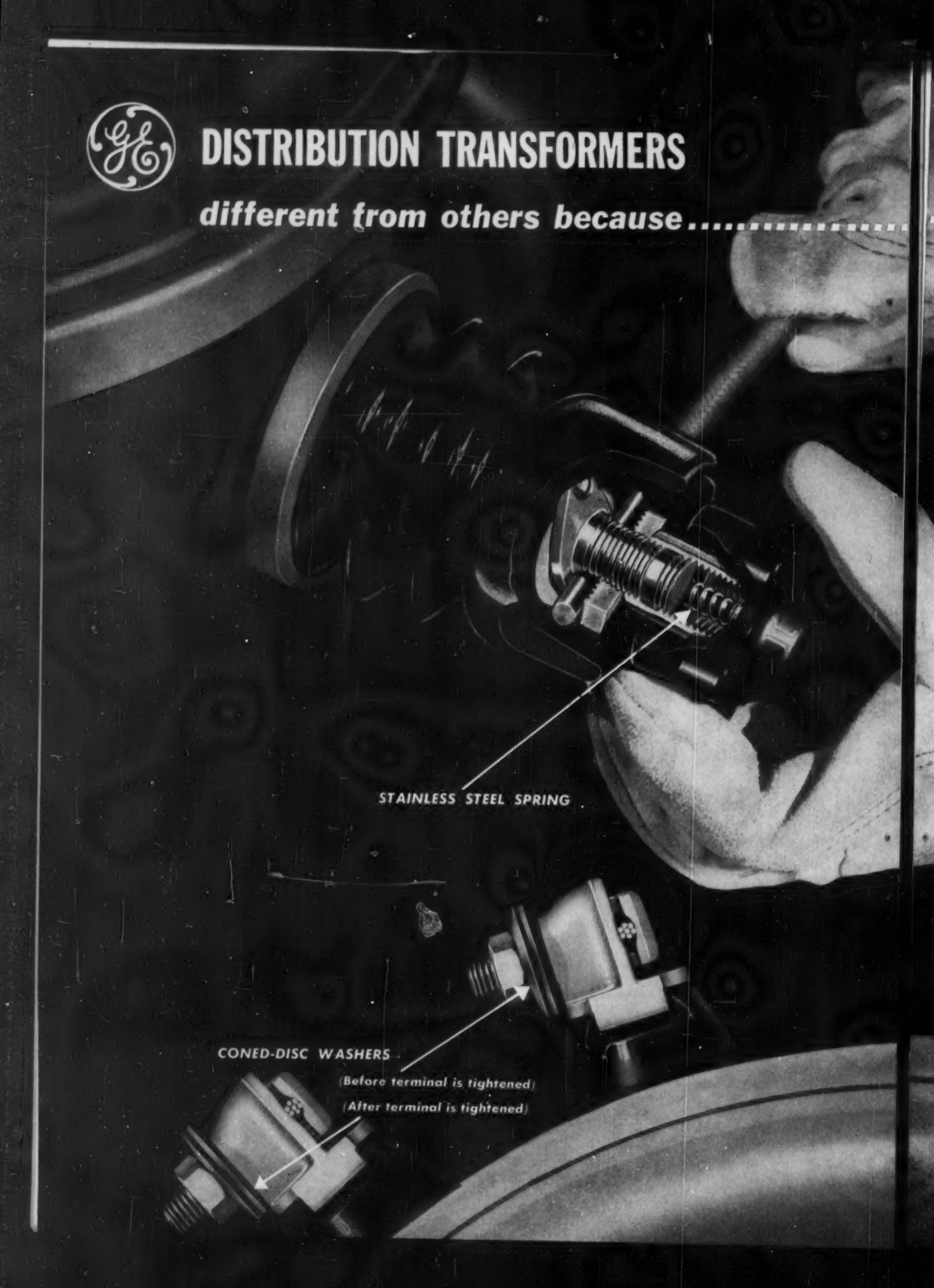


2 COMPACT only 12¾ in. high

3 LIGHTWEIGHT only 42 lbs.

DISTRIBUTION TRANSFORMERS

different from others because.....



...Bushing terminals handle both Cu and Al

retard corrosion... prevent loosening due to "cold-flow" and temperature changes

Whether you use copper or aluminum conductors, General Electric distribution transformers meet your needs—thanks to new terminals which handle both copper and aluminum without special fittings.

HIGH-VOLTAGE BUSHINGS mounted on tank wall have a stainless-steel follow-up spring bearing on an extra-large serrated contact surface, which securely grips the conductor and breaks down aluminum oxide. The spring maintains pressure on the conductor, even when "cold-flow" or temperature changes occur.

LOW-VOLTAGE BUSHINGS and high-voltage cover bushings, which feature Strenicor pressure terminal clamps, have two stainless-steel, coned-disc spring (Belleville) washers. These washers maintain pressure on the conductor in the same manner as the spring in the high-voltage tank-wall bushings.

ALL BUSHING HARDWARE is tin-plated to retard corrosion.

REMEMBER . . . all transformers are not alike . . . compare the General Electric plus features in the chart below and see for yourself.

For more information on distribution transformers, either unit-type or conventional, contact your nearest G-E Sales Office or agent, or write to General Electric Company, Section 431-12, Schenectady 5, New York.

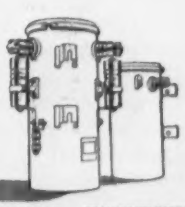
Progress is our most important product

GENERAL ELECTRIC

ALL TRANSFORMERS ARE NOT ALIKE

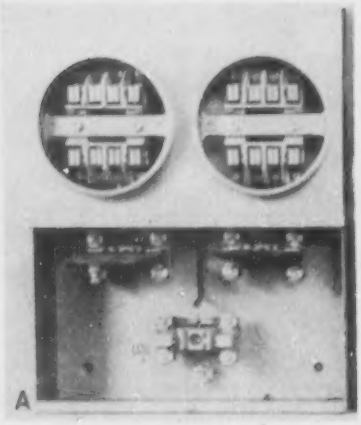
(make this simple comparison and see)

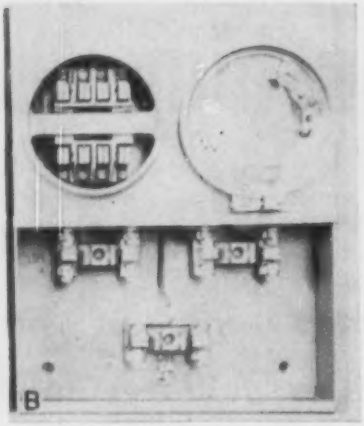
FEATURE	General Electric	Mfr. A	Mfr. B	Mfr. C	Mfr. D	Mfr. E
Production-line impulse testing	YES	NO	NO	YES	NO	NO
Nitrile rubber gaskets at all tank openings	YES	NO	NO	NO	NO	NO
Strenicor pressure terminal clamps	YES	NO	NO	NO	NO	NO
One-piece cover band	YES	NO	NO	NO	NO	YES
Terminals designed for both copper and aluminum conductors	YES	NO	NO	NO	NO	NO
Gapped valve-type arresters	YES	NO	NO	NO	NO	NO
Nationwide company-operated service facilities	YES	YES	NO	NO	NO	YES



UNIT-TYPE CONVENTIONAL

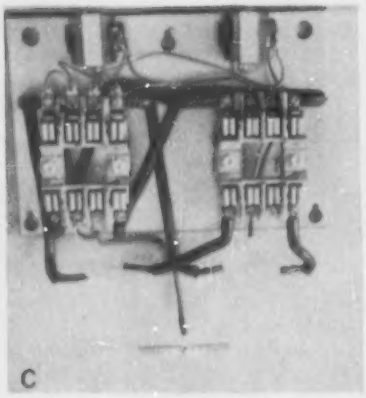
"Take your choice G. E. makes both"

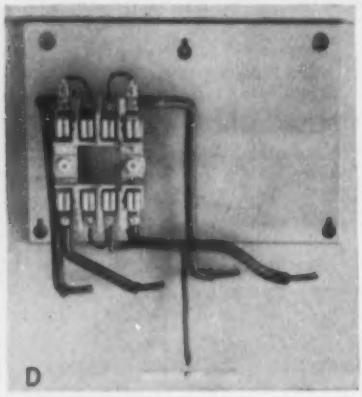




Old type meter installation

for three-phase, three wire has steel enclosure. To reset demand meter it was necessary to break seal, open window, and reseal





New style meter installation

for three-phase, three-wire metering has interior assemblies C and D, which fit into boxes as shown in A and B. A is for kw and kvar meters. B is for kw meter only

Socket-Meter Box Has Many Advantages

W. E. OSBORN
J. F. KENNEDY, Supervisors, Meter Section, Duquesne Light Co, Pittsburgh, Pa.

Polyphase socket meter boxes with factory-wired interior assemblies, developed by Duquesne Light Co, provide advantages in installation, flexibility, size, meter testing, and reading. Initial savings in using the new box are: $20.00 for a three-wire installation, and $55.00 for a four-wire service.

For easy installation, the unit comes in two parts—the enclosure and an interior assembly. The enclosure, costing $11.90, includes a two piece cover and three combination by-pass and connection blocks. It is furnished to the contractor who mounts it and connects the line and load wires to the connection blocks.

When service is to be connected, the power company installs the factory-wired interior assembly which consists of meter blocks and reactiformer, mounted on a steel panel. This panel mounts on three screws, and the wires drop into the terminals of the connection blocks that are located in the enclosure.

Maximum flexibility is realized because four different interior assemblies can be used in the same enclosure. These are for the following polyphase installations:

1. Four-wire power meter and var meter.
2. Four-wire power meter only.
3. Three-wire power meter and var meter.
4. Three-wire power meter only.

Thus, if the load of a customer having a one-meter

(*Continued on page* 125)

Comparison for Three Phase Metering

		Old A-Base Meters	*New S-Base Meters*
3 Wire	Box	$ 61.00	$ 47.53
	Meters	86.00	80.00
	Total	$147.00	$127.53
4 Wire	Box	$ 80.00	$ 70.88
	Meters	140.00	94.00
	Total	$220.00	$164.88

G-E Motors Are Custom-built for Power Station Service!

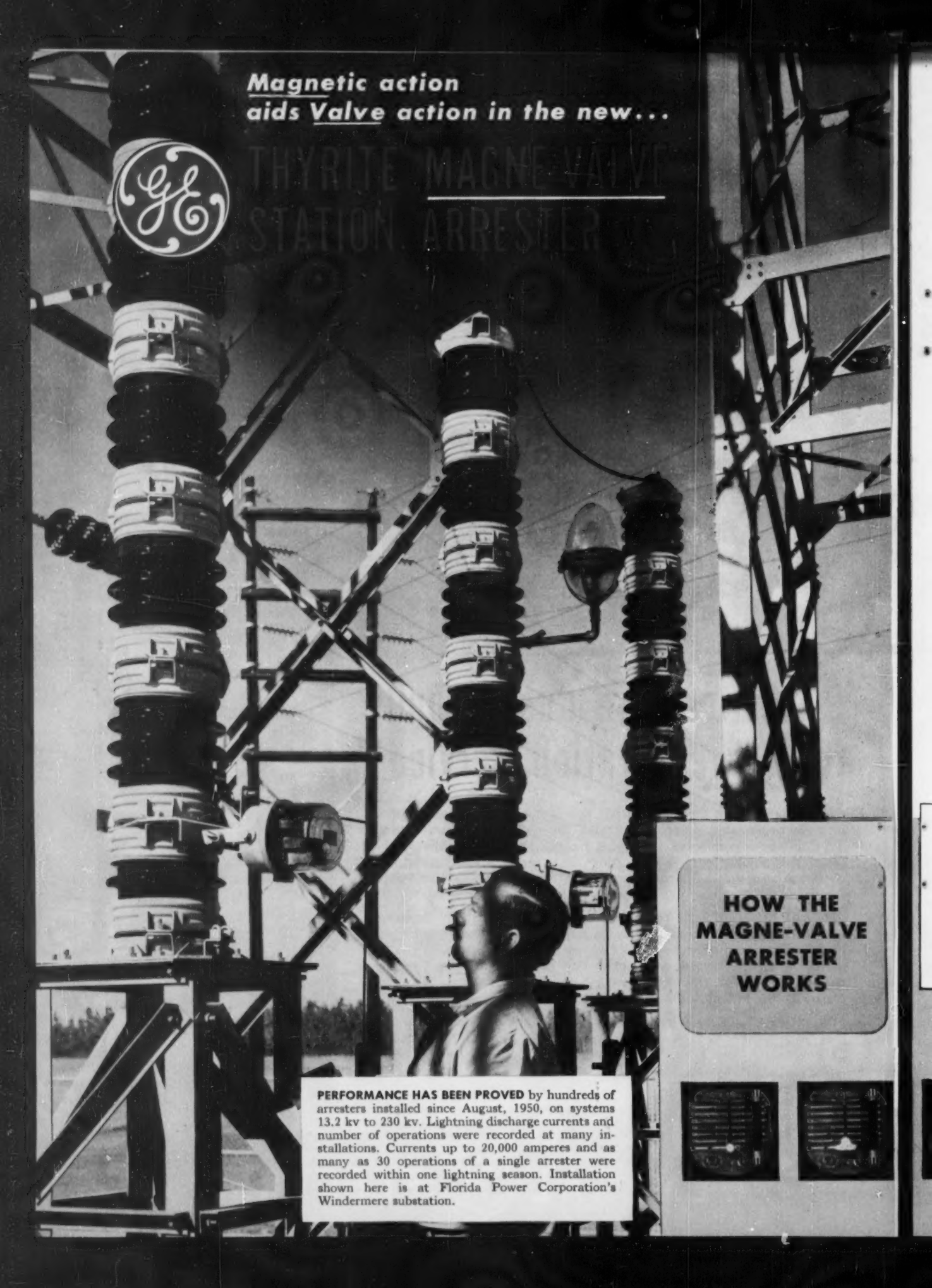
OUTDOORS OR IN, General Electric power station motors are built to give you dependable, economical service. For example, the two vertical Tri-Clad* totally enclosed fan-cooled motors, shown here, have given consistent reliable performance under all weather conditions at the A. B. Paterson Steam-Electric Generator Station of New Orleans Public Service Inc.

GENERAL ELECTRIC'S 70 YEARS of experience in designing, building, and servicing motors for power station requirements assures you of getting the right motor for the job. Whatever your needs in power station motors, G.E. can furnish a complete line including dripproof, totally enclosed fan-cooled, totally enclosed air-water cooled, and weather protected motors in both horizontal and vertical construction.

FOR MORE DETAILED information on G.E.'s power station motors, contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, New York.* 830-1

*Registered Trade-mark of the General Electric Company

GENERAL ELECTRIC



PERFORMANCE HAS BEEN PROVED by hundreds of arresters installed since August, 1950, on systems 13.2 kv to 230 kv. Lightning discharge currents and number of operations were recorded at many installations. Currents up to 20,000 amperes and as many as 30 operations of a single arrester were recorded within one lightning season. Installation shown here is at Florida Power Corporation's Windermere substation.

20% better protective level
3 times greater endurance

The new Thyrite* Magne-valve arrester is a major advance in reliability of co-ordinated protection of station apparatus. Let's appraise it!

FOR APPARATUS HAVING STANDARD BIL'S—

You get an unprecedented margin of protection that assures co-ordinated protection for many times higher stroke currents—even 100,000 amperes. This super-protection is especially valuable where lines or substations are not shielded or where practicable shielding may not be infallible.

You get an extra margin of protection which tends to offset adverse effects of separation between arrester and apparatus—enabling co-ordinated protection to apparatus at greater distances from the arrester.

FOR H-V APPARATUS HAVING REDUCED INSULATION—

You get as large a margin of safety in protecting 1-step reduced BIL insulation as was heretofore possible only when protecting full insulation (standard BIL). Hence, the new arrester enables a more positive approach toward reduced insulation and resulting tremendous savings in apparatus investments.

FOR DRY-TYPE TRANSFORMERS—

You get a good margin of protection—heretofore limited. Although oil- or askarel-filled transformers are distinctly preferable for connection to lines exposed to lightning, the decidedly lower impulse strength of dry-type transformers can now be better protected.

FOR APPARATUS HAVING DEPRECIATED INSULATION—

You get more positive protection—to preserve and greatly extend the operating life of old but important apparatus.

Reg. Trademark of General Electric Co.

FOR AC ROTATING MACHINES—

You get as good margin of protection to even impedance-grounded neutral rotating machines using ungrounded-neutral 100% rating arresters, as was heretofore practicable with only grounded-neutral 80% rating arrester. And for grounded-neutral machines, you can now limit the lightning stresses to 80% of the machine's 1-minute hi-pot test level. Both are important achievements for better protection of generators, synchronous condensers, and motors, alike.

FOR ALL THESE APPLICATIONS—

You get full-fledged uncompromised *station* arrester protection—6-inch diameter low-resistance Thyrite valve-disk with exclusive integrally fired ceramic insulating collar, the most efficient valve element ever offered.

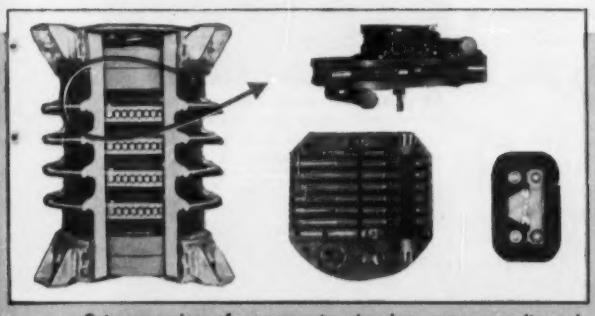
You get straight-in-line, low-resistance discharge path—28 sq. inches of cross-sectional area, with no tortuous up-and-down impedance.

You get over 3 times greater discharge capacity and thermal endurance—plenty of "guts" for withstanding high lightning currents, multiple lightning strokes, long-duration lightning discharges and severe switching surges.

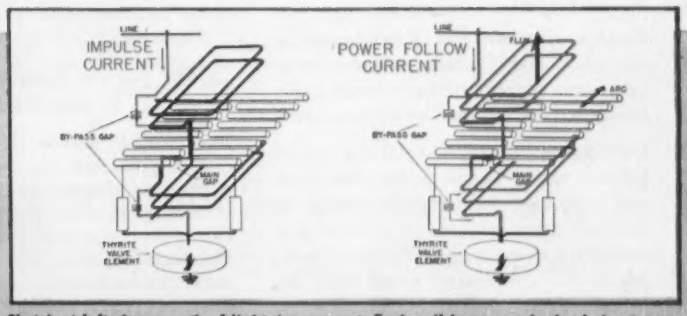
You get greater endurance now—and it protects you for future increasing discharge duty on station arresters attending trends to higher voltage lines, longer lines, greater lengths of cables, and more shunt capacitors, which increase the stored CE^2 energy in switching surges.

For more information about this new station arrester, get in touch with your nearest G-E Apparatus Sales Office or write for Bulletin GEA-1304 to Section 432-5, General Electric Company, Schenectady 5, N. Y.

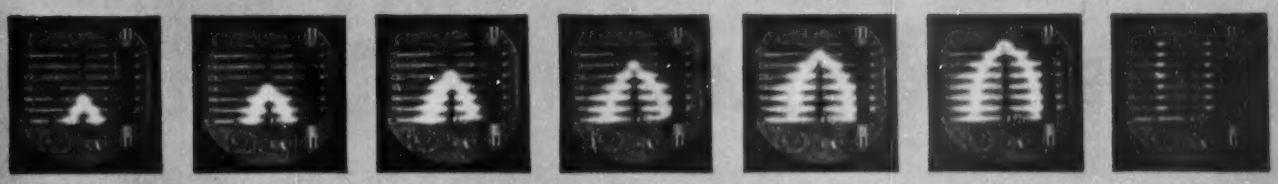
GENERAL ELECTRIC



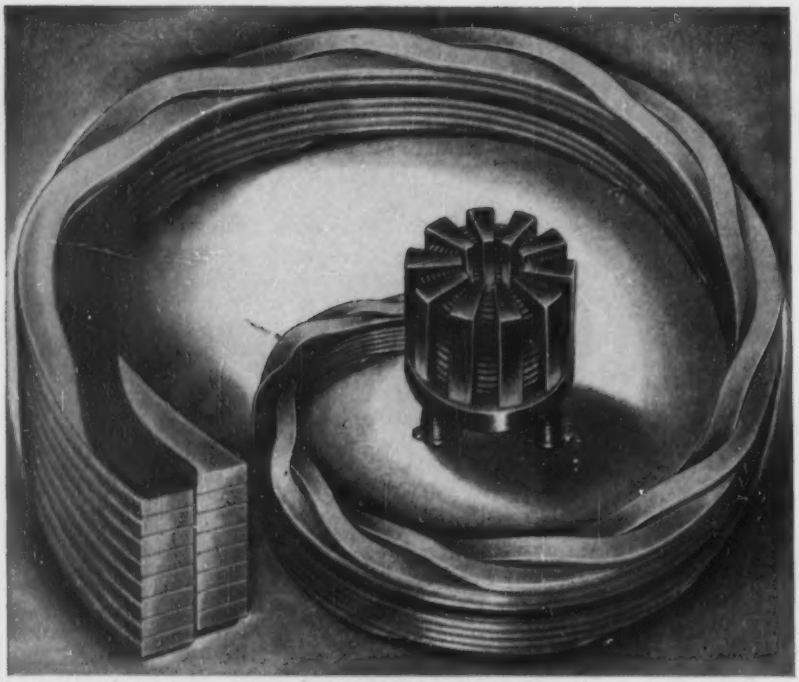
Cut-away view of new arrester showing new gap units and their components. Gap unit (circled in red) consists of 7 pairs of adjacent gap electrodes within the field of 2 magnetic coils. One pair of electrodes constitutes main gap which controls impulse sparkover sensitivity; other pairs of electrodes form multigap path for arc-interruption of the power follow-current.



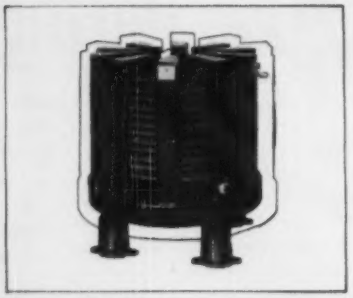
Sketch at left shows path of lightning current. Each coil has a pre-ionized shunt gap that by-passes lightning current to the discharge path shown in red. Sketch at right shows path of 60-cycle power follow-current. After lightning sparkover, the 60-cycle power follow-current flows through the coils, as shown in red, creating magnetic flux. Arrows indicate direction of magnetic flux and blowout motion of arc, which motion is the same for either polarity of the 60-cycle follow-current wave.



Film strip (from high-speed movies) shows how magnetic force sweeps power follow-current arc progressively from main gap (see extreme left) to as many as 14 multigaps in series (see second from extreme right) for efficient arc-interruption in less than a half cycle. The arc-path moves so rapidly that even hundreds of interrupting operations cause no harmful scarring or burning of gap electrodes.



CONTINUALLY TRANSPOSED RECTANGULAR CONDUCTORS—shown here schematically—are made possible by a specially designed machine. This exclusive G-E reactor feature results in more uniform current distribution and lower power losses.



COMPACTNESS Transposed conductors decrease volume up to 20%. You can fit G-E reactors in vaults too small for others.

ECONOMY By choosing G-E reactors with aluminum conductors you can save 10% on price without any sacrifice in reactor quality.

Compare . . . and you'll choose G-E Reactors

"Extra service" features of G-E cast-in-concrete reactors mean maximum protection and longer service life.

Industry's favorite for more than 35 years, G-E cast-in-concrete reactors offer you "extra service" features that make possible almost unlimited life with virtually no maintenance. For example:

Continually transposed conductor, an exclusive G-E feature, assures more uniform current distribution . . . lower losses . . . smaller dimensions.

Non-aging glass insulation gives greater short-circuit protection than any other wound insulation used in reactor manufacture . . . does not deteriorate even under high overloads . . . remains unaffected by moisture.

Wet steam curing of concrete assures full strength at shipment . . . eliminates potentially dangerous "in service" curing.

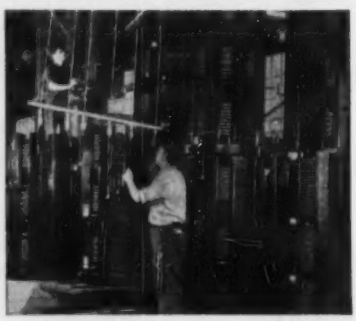
You also get such features as: good clearances; crossovers made within concrete; smooth, flameproof black phenolic varnish finish; and metal housings, complete with entrance and exit provisions, to minimize stray currents and protect reactors from damage.

And you can have a 10% price reduction!

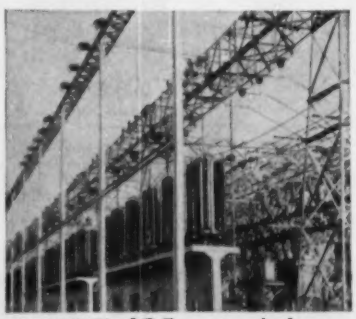
You can buy sturdy, dependable G-E cast-in-concrete reactors with either copper or aluminum conductors. By choosing aluminum conductors you can get the same long life, high short-circuit strength and low maintenance obtainable with copper conductors . . . at a 10% price reduction.

For full information contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 422-8, Schenectady 5, New York.

GENERAL ELECTRIC



AVAILABILITY You can get shorter shipments when you order RM reactors thanks to G.E.'s "repetitive manufacture" program.



DURABILITY of G-E reactors is dramatized by this 30-year-old installation. It has given no trouble, needed little maintenance.

Meter Box

(*Continued from page* 120)

assembly increases to require reactive metering, a two-meter assembly can be easily installed. Also, the same assemblies can be used for self-contained or for transformer type installations.

Removal and changing of meters is accomplished without interrupting customer service. The lower half of the enclosure cover is removed, exposing the three combination by-pass and connection blocks, and special jumpers are inserted into the blocks to by-pass the meters. As a precaution, the jumpers are such that they must be removed before the lower box cover can be replaced.

Size of the box, 3⅝ in. x 15 in. x 20 in. is much smaller than the former A-base meter enclosure, which was 10 in. x27 in. x 27 in. There is no hinged cover on the new box. The 30 lb cover on the former enclosure was awkward to handle, and it extended 33 in. from the wall when open, thus prohibiting its use in narrow passageways. The new socket meter box has been installed in several locations where it was formerly impossible to use the old enclosure.

Demand reading is faster and more convenient now. There is no extra window to open and reseal in the new box as there was in the former one.

Meter testing is now done by using a special test jack in the power meter side of the box. However, as more and more of these installations are made, it is planned to remove the meters to a test truck or to the shop for maintenance and test.

Concrete Pyramids Protect Bank from Erosion

Pre-cast concrete pyramids placed along a waterway near White River hydroelectric plant protect the bank from erosion. Puget Sound Power & Light Co has found that the pyramids provide the more economical protection for the waterway than by using riprap.

Rock riprap, which ordinarily would have been used, would have had to be trucked some distance while the pyramids were cast at the power plant from readymix concrete trucked from a nearby town. Each pyramid weighs about 3,000 lb, measures 4½ x 4½ ft at the base, and is 4 ft high. Double steel eyes were cast in the top and base for ease in handling by a truck-boom.

CONCRETE PYRAMIDS, pre-cast six at a time at the power plant in the background, were trucked to river's edge and placed to protect the bank from erosion

Thirty pyramids were lowered over the eroding bank to the edge of a swirling stream at a point where a timber-lined canal empties into an earth canal. During low water rockfill from a river bar 100 ft downstream will be pushed in behind the pyramids with a bulldozer to further line the eroding bank of the waterway.

Cost of the pyramids is estimated at about half the cost of rock riprap. Thus, considerable money was saved by using the pre-cast concrete pyramids rather than the more customary riprap.

CENTRAL CONTROL ROOM arrangement permits operators to watch the boiler boards (center) and electrical board (right) at same time

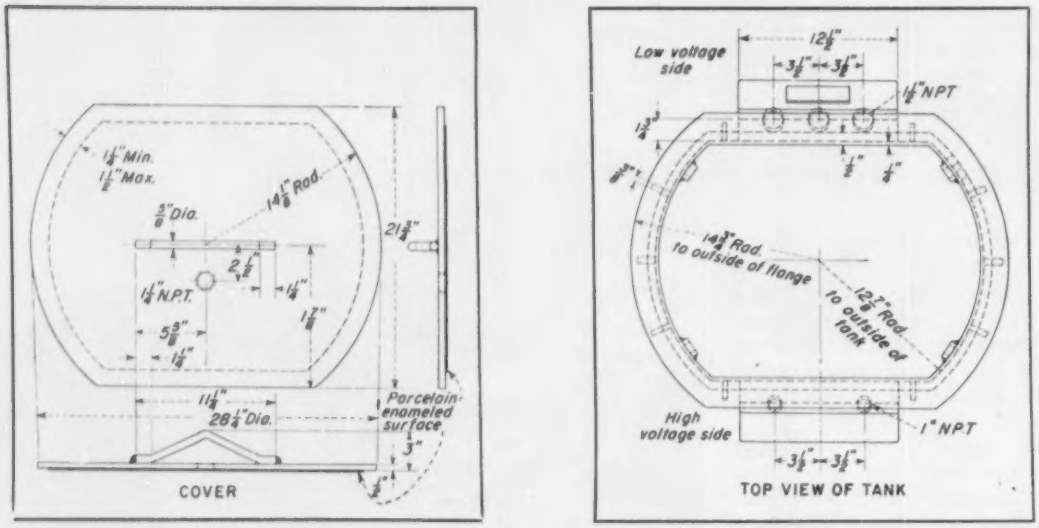
Combustion and Load Control Provide Efficient Operation

Combustion and load-control features have been incorporated in the Hennepin Station of Illinois Power Co. Combustion-rate anticipator controls the 525,000-lb-per-hour boiler and continuously watches for changes in electrical demand. Load-frequency control in the station provides a vernier adjustment of the master control applied from the dispatcher's office.

For combustion control, electric impulses that regulate the turbine governor setting are fed into the combustion

(*Continued on page* 128)

How Welded Steel Covers Can Be Removed from Transformer Tanks



OUTLINE OF COVER and top view of steel tank for underground distribution transformers in sizes of 75 and 100 kva

This procedure is an adaptation from Work Method Standards of Boston Edison Co.

Equipment

1. Cylinders of oxygen, acetylene and nitrogen. Two-stage oxygen regulator for 80 psi working pressure. Two-stage acetylene regulator for 5 psi working pressure. Two-stage nitrogen regulator for 2 psi working pressure. Twin 5/16-in. I.D. hoses for oxygen and acetylene, cutting torch with 90 deg head, and gouging tips. Nitrogen hose and test fitting.

2. Accessories. C-clamps, hammer and chisel. Gloves and goggles. CO_2 extinguisher. Canvas screen (if cutting indoors). Metal dolly. Cutting platform.

Removing Weld

1. Drain oil until oil level falls just below oil sampling valve.

2. Remove top oil sampling device and insert test fitting in its place.

3. Connect hose from nitrogen cylinder through test fitting to top oil sampling device.

4. Adjust nitrogen regulating valve to deliver 2 psi.

5. Remove oil-filling fitting from cover. Allow nitrogen to flow through this opening for at least one minute.

6. Replace oil-filling fitting and crack it so that moderate flow of nitrogen is obtained.

7. Assemble gouging tip to torch at most convenient angle for weld removal.

8. Adjust acetylene pressure to 5 psi.

9. Adjust oxygen pressure to 80 psi.

10. Place transformer on dolly.

11. With neutral flame heat weld to white heat at corner of tank. Simultaneously, set torch in motion along weld and release the cutting oxygen. Continue moving torch axially along weld with flame feeding onto uncut weld. Gauge depth of cut so entire weld is removed in one pass. When sufficient weld has been removed, a fine crack will appear along the juncture of cover and flange. As cutting progresses, transformer shall be rotated so that direction of flame and sparks is always away from other personnel and equipment and towards either a door open to the outside or a cleared area.

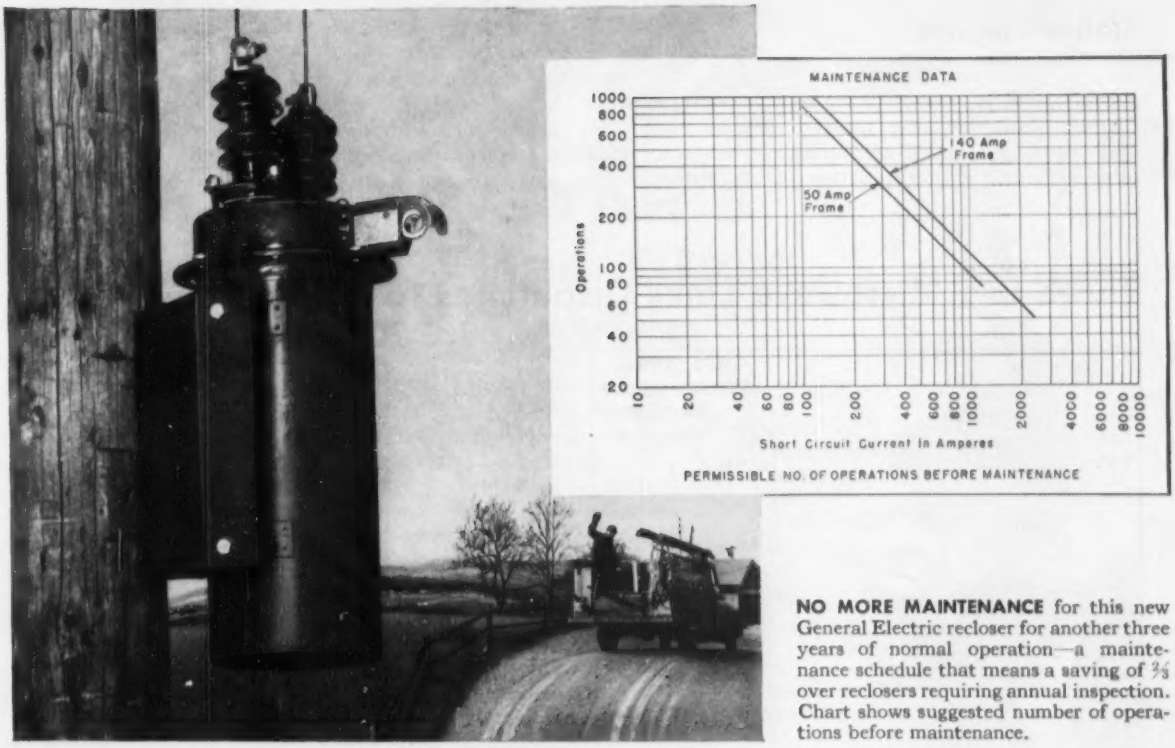
12. Apply clamps to sides from which weld has been removed. This prevents joint from opening prior to complete weld removal.

13. As nitrogen begins to escape through opened seam, reduce delivery pressure for moderate flow.

14. After weld has been completely removed, fully close nitrogen regulating valve, release clamps and break weld seal by driving point of chisel directly into roof of joint. Move slowly along joint applying lifting force to cover.

15. Remove any loose weld metal that remains on the flange of the tank.

Procedure for welding covers to steel transformer tanks was outlined in ERS No. 54-12 (EW, June 14, 1954, p. 134)



NO MORE MAINTENANCE for this new General Electric recloser for another three years of normal operation—a maintenance schedule that means a saving of ⅔ over reclosers requiring annual inspection. Chart shows suggested number of operations before maintenance.

Now—save 66% on your recloser maintenance costs

G.E.'s exclusive Type FR Automatic Reclosers reduce need for inspection and maintenance to *only once in three years*

Now General Electric offers you a recloser that calls for less maintenance than any other recloser manufactured today. You can hang a new G-E Type FR automatic recloser on the pole and forget it for three years of normal operation. That's two years longer than the inspection and maintenance time considered normal for all reclosers. You save two-thirds of your recloser maintenance time and expense.

REASON FOR THIS LOW MAINTENANCE is the new "sealed-unit" design of the FR recloser. All points are effectively sealed from moisture and dust which cause oil contamination. The recloser is protected with a special rubber-seal operating handle which allows interruption gases to escape from the tank but prevents outside air from entering.

LONGER LIFE IS THUS ASSURED because moisture-laden air and dust are kept out. This prolongs the insulation ability of the oil and makes practical the use of inhibited oil which is furnished with all G-E reclosers.

AVAILABLE IN the single-phase FR-1 model and the three-phase FR-3, continuous current of 5 to 140 amps, interrupting capacity of 125 to 2500 amps at 2400 to 14,400 volts—this G-E recloser design is completely interchangeable with other makes.

For more complete information on these reclosers, see your General Electric Sales Representative, or write for Bulletin GEA-5961, General Electric Co., Section 502-4, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

Station Controls

(*Continued from page* 125)

control master in advance of the resultant steam pressure change. Thus, the boiler tends to respond directly to load swings. Subsequent steam pressure changes are used to provide final corrective action. These actions result in uniform steam header pressure, and efficient unit and system operation.

Load-frequency console at Hennepin, similar to the one at the company's dispatching office, regulates participation of individual generators. Similar controls are provided at the company's other stations. Thus, low incremental generation cost of stations and the system is realized.

Three-Leg Microwave Links Dispatches to Station

DOUBLING BACK PG&E's new microwave link ties the Oakland load dispatcher to the Pittsburg steam plant over the Mt. Diablo repeater

R. L. BRINTON, Gen. Supt. of Communications, Pacific Gas & Electric Co, San Francisco, Calif.

By doubling-back from Oakland to San Francisco across San Francisco Bay, Pacific Gas & Electric Co is establishing a three-leg line-of-sight microwaves link from the dispatcher's office to the new 600,000 Pittsburg Steam Plant (EW, April 19, p 116). High hills east of Oakland ruled out a line-of-sight path to a repeater station on the highest mountain in the East Bay. The repeater will allow for future expansion of microwave to three other points.

Microwave will be the communications "backbone" for the load dispatcher to the new steam plant. Licenses have been obtained to install an 1,850-2,000-Mc microwave link with terminals at Oakland, San Francisco and Pittsburg, and a repeater on Mt. Diablo. The link between San Francisco and Oakland is designed for 30 channels ultimately but will have 8 channels initially. The San Francisco-Pittsburg link is designed for eight channels with three channels to operate initially. Additional channels up to 30 can be added between San Francisco and Mt. Diablo and extended to Stockton, Sacramento and the Vaca-Dixon Substation through the Mt. Diablo repeater.

Based on 2½ years of experience with Oakland-Newark 952-960-Mc link, microwave has become the most dependable type of communication for PG&E. Maintenance costs are low compared with wire lines; dependability is even better than that of power line carriers. Both power line carrier and wire lines are frequently affected by system troubles while microwave is not. In addition, microwave provides diversity from other forms of communication. Additional channels may be added at relatively low extra cost once the initial system is installed.

On the Pittsburg-Oakland system power line carrier could not have been used due to frequency congestion. Present methods utilizing two frequency-duplex, double-side-band amplitude modulation have been too wasteful of the 50-200-kc power line carrier band. Only a few channels now remain between 150-200 kc in the San Francisco Bay area. Thus, when two or more channels are desired between two points, the expansion for dispatching channels will be via microwave.

Pipe-Frame Lift Aids Truck Loading or Unloading

DONOVAN W. BORING,
WILLIAM G. MILLER, Substation Dept, Ohio Power Co, Portsmouth

A simple pipe frame hinged at the sides of a heavy-duty truck, and operated by a line from the power-driven winch easily handles 50 to 100-kva transformers. One man con-

(*Continued on page* 130)

HINGED FRAME is operated by power winch line. It facilitates loading and unloading transformers and other equipment on trucks

Blast the Arc

with DELTA-STAR'S New "JT-1" Gas Blast Interrupting Device

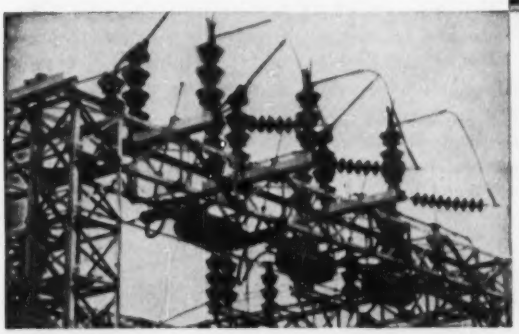
Delta-Star's new "JT-1" interrupting device for use with standard air switches is now ready for installation on your transmission systems. Extensive laboratory and field tests including many actual installations have proved the "JT-1" to be the ideal device for use on transmission lines from 69 to 161 kv where circumstances do not require the interrupting capacity or justify the use of a circuit breaker. With the "JT-1" installed on your air switches light loads can be interrupted without danger of long arcs causing phase-to-phase faults.

The "JT-1" is a gas blast device utilizing compressed nitrogen or air to "blow out" the arc at the contacts of a switch immediately after the arc has formed. The gas blast is controlled by a cam operated valve mechanism under each switch unit which is in turn operated directly by the switch operating mechanism. These valves open automatically when the switch blade reaches a predetermined position.

Since arc extinction does not depend on gas expulsion by disintegration of an arc chamber an unlimited number of operations are possible without replacement of parts.

The next time you have a problem where switches must be operated under load or long lines dropped, investigate the possibility of using Delta-Star "JT-1" interrupters. For full particulars write the factory or nearest district representative.

▲ "JT-1" Interrupter mounted on 115 kv "MK-40" disconnect.



◀ Installation of "JT-1" Interrupters on 115 kv "MK-40" 3-pole group operated switches. Photo shows blade position immediately after arc was extinguished.

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHING EQUIPMENT SPECIFY DELTA-STAR

DELTA-STAR ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.
OF PITTSBURGH
2437 FULTON STREET, CHICAGO 12, ILLINOIS
DISTRICT OFFICES IN PRINCIPAL CITIES

Pipe-Frame Lift

(*Continued from page* 128)

trols the power-driven winch while a second man attaches the load to the lift and directs operations.

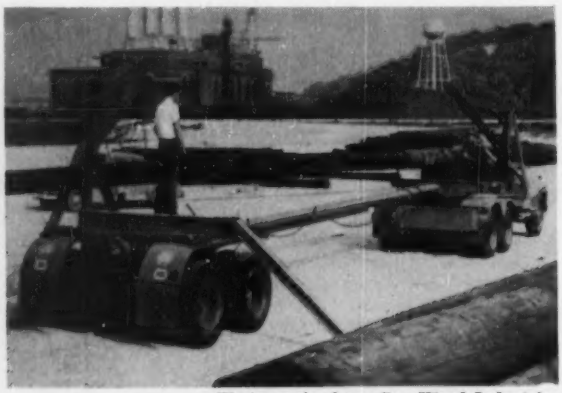
The lift which takes the place of a hydraulic unit is less expensive and does not require storage space. When not in use, the hinged pipe-frame is swung into a vertical position and held securely by inserting pins through lugs in the top of the frame.

Cross-piece of the hinged frame was made of one 6-ft length of triple-strength 2-in. steel tubing. Legs were made of salvaged boiler tubes joined to the horizontal member. Each joint consists of a 12-in. section of pipe sleeve to which is welded a gusset plate. The plate fits into slots in the leg and is welded in place.

Each leg is flattened where it is hinged with a 1⅛-in. bolt to parallel triangular plates bolted to the truck floor. Welded to the outer end of each leg is a lug with a hole which is locked to similar lugs at the top of the truck side frame with pins when the frame is not in use.

Entire construction of the hinged frame of salvaged materials including welding and installation was done by the substation crew at an estimated cost of less than $25.

CRANE AND WINCH are important components of this equipment. Crane lifts one end of pole onto truck. Line from winch goes to . . .



MASTBOOM EQUIPMENT on back end of the hauler and pulls the other end of the pole up an I-beam slide and onto the bed of hauler

Photographs from Gar Wood Industries

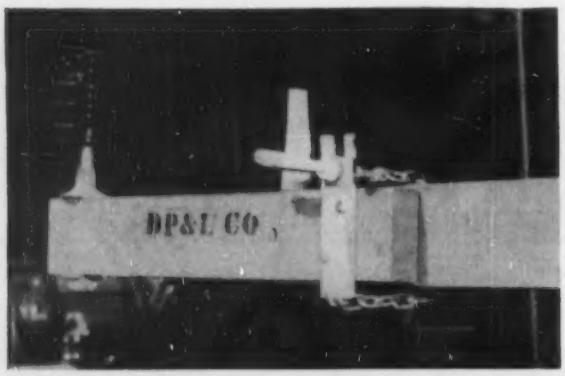
Special Equipment Simplifies Pole Handling

A pole hauler and special truck equipment has simplified Dayton Power & Light Co's pole handling. A substantial saving of time and labor has resulted. Two men can easily and quickly load and unload poles of any length.

Poles are handled with a crane, having a 1.9 ton capacity at 6½ ft boom radius, and a winch mounted side-by-side behind the cab of a truck. With the pole hauler hooked to the truck, a pole is lifted by one end and swung onto the truck with the crane. The winch, pulling a 15,000-lb capacity cable through a sheave and mastboom on one end of the pole hauler, skids the other end of the pole up an I-beam ramp and onto the bed of the pole hauler.

Both crane and winch operate independently through the same power take-off. Power hoisting and lowering of the load are controlled by a single lever at the side of the crane frame which operates a reversing gear box to positively control hoisting, holding, and lowering. A self-energizing, automatic safety brake on the winch will stop and hold any load up to the winch rating.

With the pole hauler unhooked, the truck becomes a versatile piece of equipment. Crane can be used for lifting relatively light, bulky loads and the winch used for pulling.



CROSSARM EXTENSION slips in place easily and is held by chain fitted with bolt and take-up eye. Countersunk holes fit over ends of through bolts or double arming bolts to hold extension in place

Crossarm Extension Aids Wire Stringing

Crossarm extensions have greatly simplified and speeded the replacement of primary conductors or the stringing of additional conductors on an arm carrying 13-kv primaries on the Dallas Power and Light system. Made of

(*Continued on page* 132)

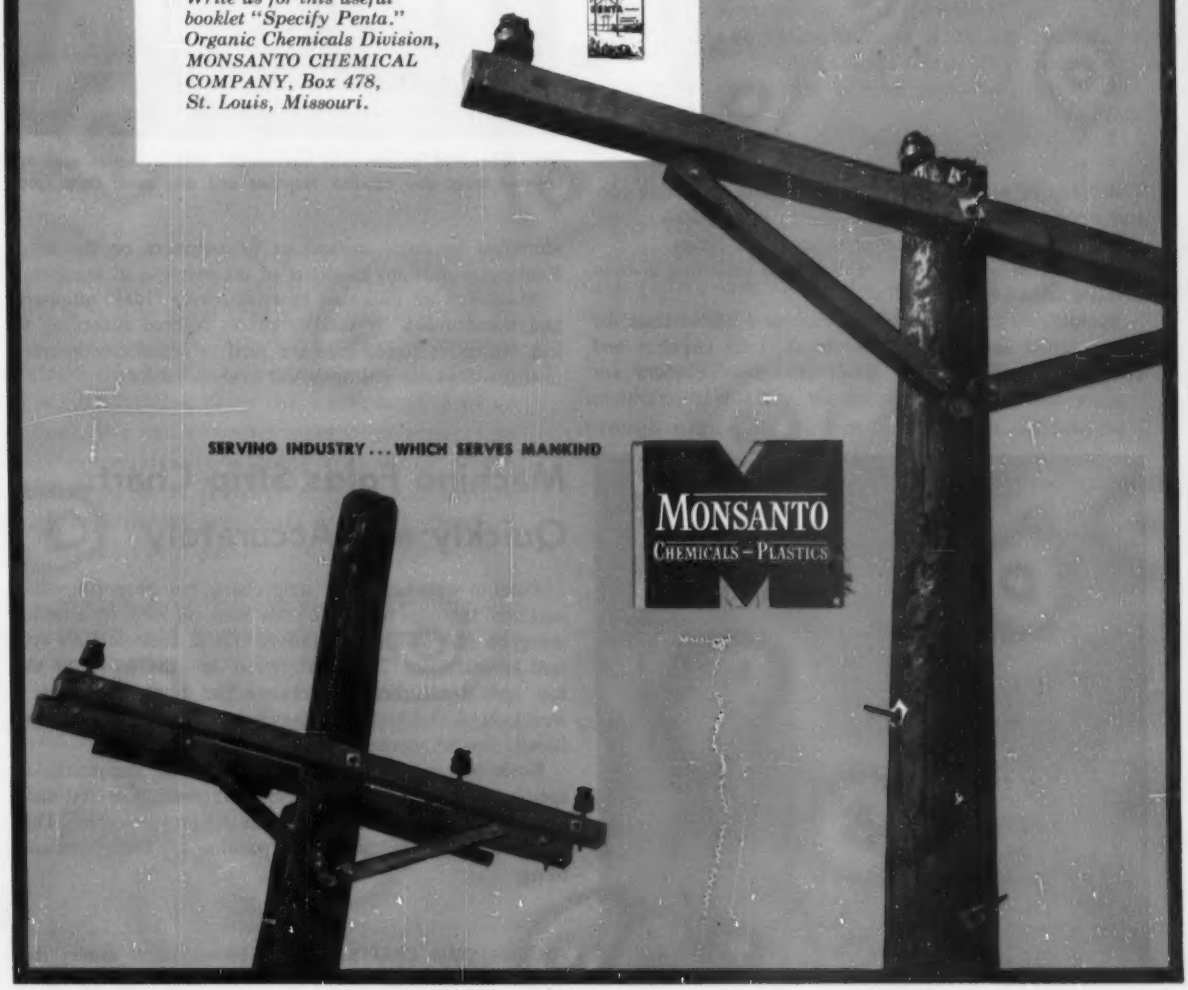
For Pacific Gas & Electric—

MONSANTO PENTA GIVES WOOD 4 LIVES

POLES AND CROSSARMS treated with Monsanto Penta will have at least four times the service life of untreated materials. Penta—on the job for Pacific Gas & Electric Company—protects wood against decay and insect attack for many years.

LINEMEN LIKE PENTA-TREATED WOOD. It's clean, easy to handle, does not irritate the skin or "burn" hands. Penta in wood is not messy, will not bleed out to stain clothing. It leaves wood paintable if specified. When you specify Penta, you protect your investment in a farsighted way: well-preserved, clean poles are an asset.

Write us for this useful booklet "Specify Penta." Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478, St. Louis, Missouri.



SERVING INDUSTRY . . . WHICH SERVES MANKIND

MONSANTO
CHEMICALS – PLASTICS

Crossarm Extension

(*Continued from page* 130)

2 x 4 x 24-in. timber and equipped with a steel pin and insulator, the extension permits moving existing conductors out of the way while new ones are being pulled in.

A ⅜ x 8-in. strap is bolted to the extension. A lightweight chain, fastened to the strap below the bottom of the extension, is run around the crossarm and tightened with a take up eye which slips easily into a slot at the top of the strap.

Countersunk holes, drilled in the extension, fit over through bolts or double arming bolts. This holds it firmly in position.

Sliding Panels Facilitate Examining System Maps

To facilitate examination of system maps and line diagrams, Boston (Mass.) Municipal Light Department's operating office has built a portable frame carrying sliding panels to form a compact vertical file. The panels are 4 ft square, built of ¼-in. plywood, and set with centers about 5 ft 8 in. above the floor to provide easy reading near eye level.

Panels slide back and forth in grooves between cedar strips. Each groove is ¾ in. wide and the bordering strips are ¾ in. square. Handles, made of scrap plywood attached to the panels, are ¼ in. thick and are staggered to permit back and forth movements without interference. Maps and diagrams are printed on sheets which allow changes to be made readily by erasure.

Attached to the panels are the following:

1. Primary switching map of central section of town, scale 400 ft per in.

2. Map of the 12, 3-phase, 2.4-kv primary circuits.

3. Map showing transformer locations.

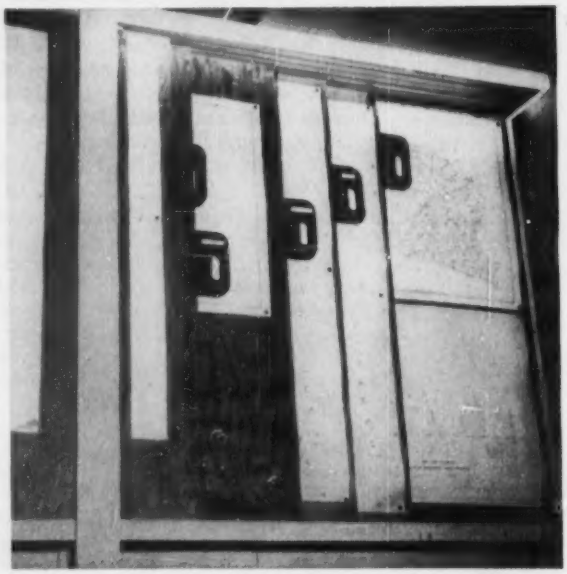
4. Map of street lighting control circuits, including control circuits for off-peak water heating installations.

5. Map showing location of series street lamps.

6. General map of town of Belmont, including civilian defense areas.

Symbols on the maps include dash and dotted lines for underground and solid for overhead. Line switches and cutouts are indicated by small triangles. Feeders are identified by color instead of by numbers on the map. Rectangles indicate locations of oil switches in manholes.

Manholes are indicated by circles with "MH" numbers, and transformers by smaller circles colored according to kva ratings. Colored pins are used to indicate temporary changes in switch positions and to show faults.



VERTICAL FILE permits easy examination and inspection near eye level of maps and one-line diagrams and also saves floor space

FOLDING STRIP CHARTS in system laboratories is accomplished quickly and accurately with this machine that was built by J. P. Jones

Machine Folds Strip Charts Quickly and Accurately

Folding watt-var meter strip charts has been simplified and time required for the job has been cut 90% by a folder designed and built in Oklahoma Gas & Electric Co's system laboratories. The chart is fed into the folder at the top and is secured in position. The operator works a shuttle back and forth and the chart is folded as fast as the handle can be operated.

Folds are nine in. long, three hours on the chart. A spring mechanism maintains the chart position so that each fold is precisely the same length as the previous fold. This keeps dates and hours in right position for inspection and filing.

Note the symbols on the head of this suspension insulator disc. First, the impressed number 406254 (read it 4-062-54) means that Crew No. 4 made it on the 62nd day, or March 3, 1954. The big stamp No. 3 denotes the glazing crew. The stamp "J" is the inspector's mark. Factory records would enable us to name the men who handled it, to find the individual die that formed it, and on what machine, to check the tested composition of the clay and glaze, and to review the laboratory records of statistical control governing the batch of which this insulator is a part. At least a dozen men have "signed their name to it!" We will always be able to back-track through each pair of hands and each process to pin-point a possible improvement.

TC

Insuring the Chance to Make it Better

On the head of each O-B suspension insulator disc is this information: The day it was made, the crew that made it, the crew that glazed it, and the inspector that passed it. Detailed production records can extend this back to a certain batch of clay, to a single forming die, or to the workmanship of an individual. We can examine laboratory reports on the raw material before going into stock, or on destructive M & E tests of a statistical control quantity of finished insulators from the group of which this unit is a part.

Because each piece bears an identity, testing and inspection can lead to more effective manufacturing control, permitting us better to correlate materials, processes, and human skills. And, if at any future time we wanted to trace back the history of some single unit, we would have its complete birth record that might be invaluable in guiding us to possibly more knowledge of our business.

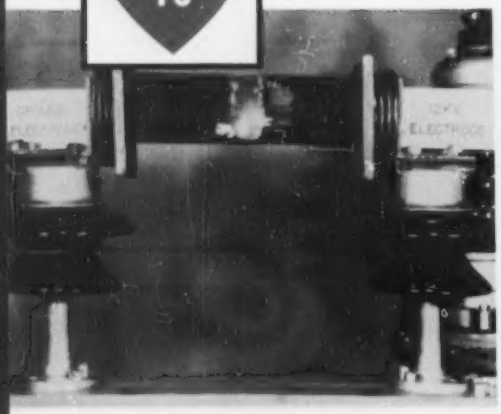
If we seriously intend to maintain and increase fundamental quality, we must be able to back-track through each pair of hands and each process to pin-point a possible improvement.

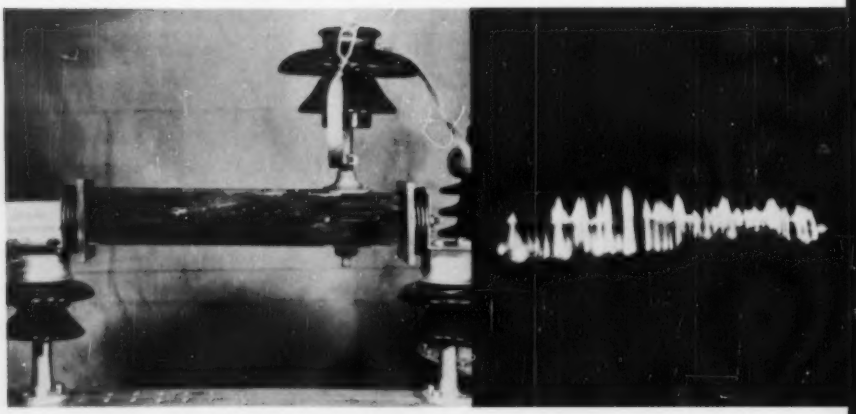
This kind of care -- this acknowledgement that there is still room for improvement in anything, no matter how good, (and we don't want to miss the chance through lack of identity) is one of the most practical aspects of Technical Competence, the heart of every O-B insulator!

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

A Couple of Feet of Scrap Wire

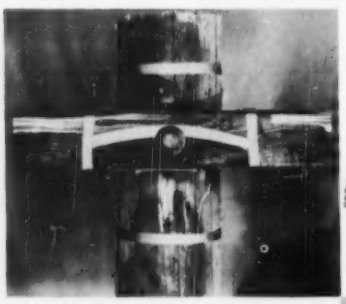


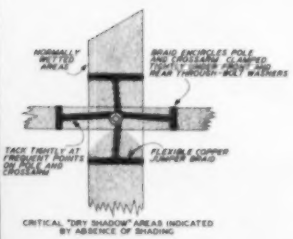


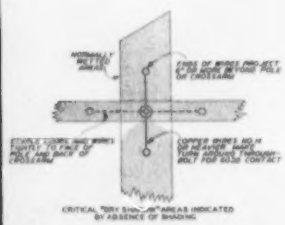
The principle: Electrical break-down over a small dry area on an otherwise wet, conductive pole or crossarm, is the fundamental cause of fires. Such "dry shadows" are created by wind-directed rain or snow. They require a previous dry period to permit the structure to reach a low moisture content, and are then a function of contamination on the insulator combined with gentle, selective wetting. The surge nature of leakage currents involved has been established in our laboratory from the data obtained on our outdoor time-tests.

Air-driven spray has lightly wetted wood surfaces and reduced their resistance. Only 10 milliamperes flowing over the crossarm initiated this "tree fire." Heat of the fire has dried progressively longer sections of the grain, and conductivity of these carbonized paths offsets what would otherwise be increasingly longer resistance elements. Note electrical sparking within the wood grain structure. The ultimate result of such a "tree" fire is destruction of the crossarm as shown in the second view. Many such fires die out or are extinguished in their early stage by increased intensity of rain. This accounts for the presence of surface "tree-burn" formations.

THREE SUGGESTED MEASURES FOR PREVENTION OF POLE FIRES BY SHUNTING OUT "DRY SHADOW" AREAS




NORMALLY WETTED AREAS
BRAID ENCIRCLES POLE AND CROSSARM, CLAMPED TIGHTLY UNDER FRONT AND REAR THROUGH-BOLT WASHERS
TACK TIGHTLY AT FREQUENT POINTS ON POLE AND CROSSARM
FLEXIBLE COPPER JUMPER BRAID
CRITICAL "DRY SHADOW" AREAS INDICATED BY ABSENCE OF SHADING



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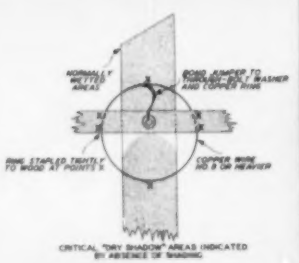
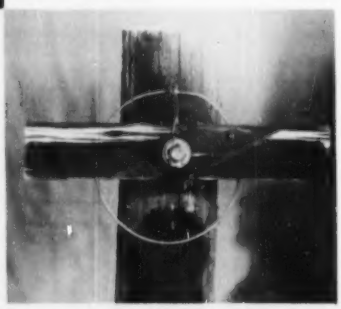


CRITICAL "DRY SHADOW" AREAS INDICATED BY ABSENCE OF SHADING



Keeps the Fire Department Home

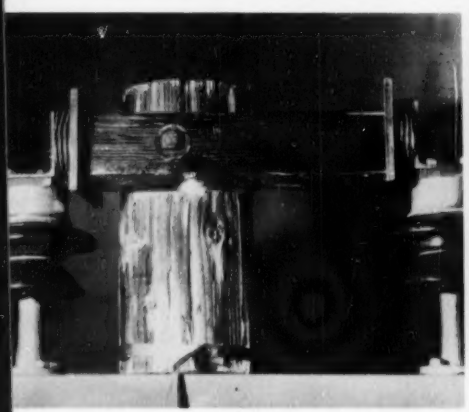
After a day when 14 pole fires were burning at the same time on its property, an exasperated power company came to our laboratory with the question: "What do you know about the cause and, better yet, the cure of such fires?"

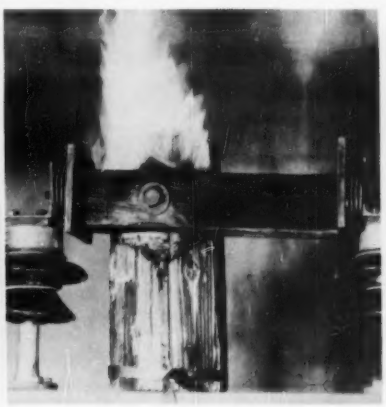
No books were available on this subject and no conclusive research had ever been conducted until we undertook to answer the question -- a project that consumed more than two years.

Eventually, a series of factors was closely correlated: (A) Low moisture content of the pole. (B) Presence of conductive contamination on the insulator. (C) A critical degree of precipitation. (D) Wind velocity. (E) Wind direction in relation to elements of the structure. As our knowledge of the subject improved, an observer could describe a certain type of pole fire and, by arranging the volume and angle of water sprays, plus directing a controlled air blast, the laboratory could produce the fire to specification. The technicians became so familiar with the phenomenon that they even predicted a fire on our factory primary service!

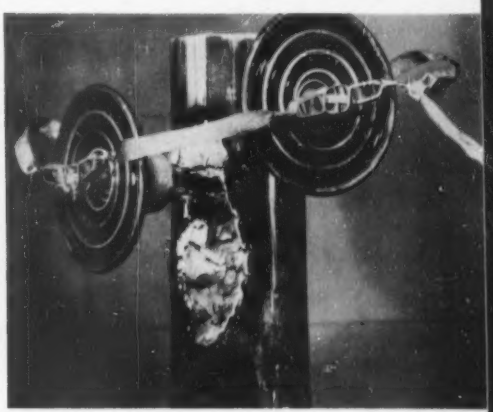
As for the cure -- a couple of feet of bare wire stapled to the pole and crossarm, or other equally simple measures. Details of this research project are in the 1947 A.I.E.E. Proceedings under the title, "Burning of Wood Structures by Leakage Currents," as presented before that year's Winter Technical Meeting. A letter addressed to us will secure a copy of this paper without charge.

Behind this is a story far more important than conducting one more piece of useful, practical research relative to insulation and power transmission. First, there are the physical and human facilities of the finest laboratory in the insulator industry. But we go another step back to the attitude of Management that continually fosters and promotes such research in recognition of this important fundamental: that, while machinery and factories may be the mechanism of making an insulator, Technical Competence is the heart of it.





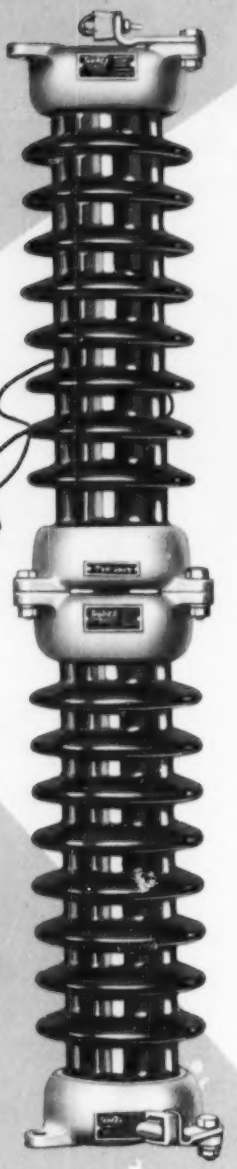
Start of a severe "pocket" fire adjacent to the gain in a pole. Leakage current of 10 milliamperes is flowing from the dampened crossarm surface to the through-bolt, through the dry gain area, and out over the lower surface of the dampened pole to ground. Confinement of such a fire makes it unlikely to be extinguished by natural rain. The second view shows the fire which has progressed to open flame.

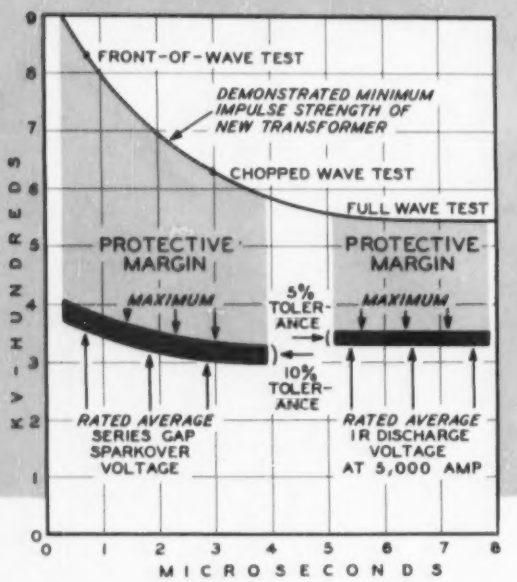


One can almost visualize the "shadow" of the suspension insulator on the left against the face of this pole. This is a typical fire as occurring on a deadend. The test was stopped after the point of open flame, in order to relieve smoke conditions in the laboratory although, in the field, destruction would be complete. It will be noted in this and another view, that the insulators are jumpered. The function of the unit in the test is only to cast its shadow rather than to transmit leakage currents. These currents are produced by the test equipment in accordance with known surge data.

TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

Take A Realistic Look at LIGHTNING ARRESTERS





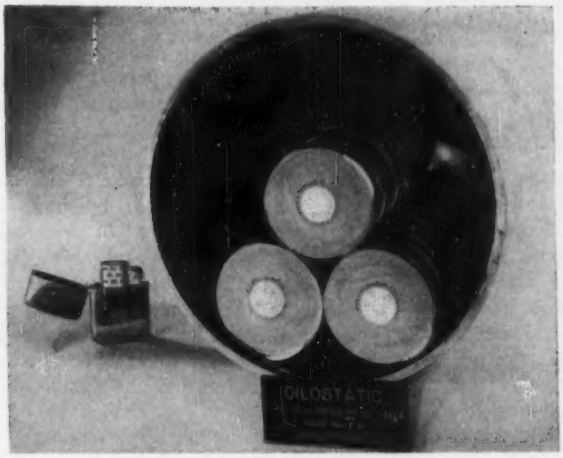
Protective Margin, as illustrated in this typical application curve, is that zone existing between MAXIMUM arrester protective rating (tolerance added to average rating) and minimum insulation strength of equipment.

Here is a *fact* worth looking into: The Thorex GP-60 lightning arrester, as normally applied to 69-kv service, costs you only $1.63 per kv of IR discharge protective margin, at 5,000 amperes. Furthermore, it provides you with an over-all quality of protection that has put it -- successfully -- into some of the toughest "arrester-killing" spots in the power industry. It's simple to get at the heart of the question and analyze the *cost* of protection, as well as evaluate the quality of it. When you take this realistic view you will do as hundreds of others have done, and protect your major equipment with Thorex.

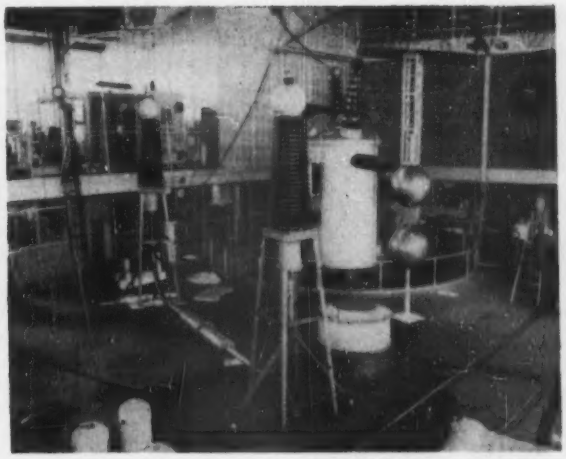
Ohio Brass

MANSFIELD OHIO • U. S. A.

4412-H



SECTION OF FIRST 230-KV PIPE-TYPE CABLE SYSTEM made in U.S.A. shows relative size of pipe and insulated conductors



230-KV POTHEADS WITH CABLE AND SPLICE are arranged for impulse tests in the Ohio Brass Co laboratories in Barberton, Ohio

For Cubatao underground power plant in Brazil . . .

Okonite Will Supply 230-Kv Pipe-Type Cable

The first American-built 230-kv, high-pressure, pipe-type cable will be shipped late in July by the Okonite Co, Passaic, N. J. Its destination will be the Cubatao underground power plant of Sao Paulo Light & Power Co, Ltd, in Brazil. Pipe for the cable system has already been shipped.

Initial installation will be four circuits, each about 1,500-ft long, for four 80,000-kva generators. Two additional steel pipes will be installed to take care of circuits for two more 80,000-kva units.

The system was designed by Okonite engineers in cooperation with Canadian-Brazilian Services, Ltd, Toronto. The design of the pothead terminals was developed with the assistance of Ohio Brass Co's technical staff.

The high-pressure (275 psi) oil cables will be installed without splices. Cables will be fed into a spreader head on a vertical 90-deg bend in the 8-in. IPS steel pipe leading into a tunnel to the underground station.

The 8 5/8-in. OD, 0.25-in. wall, steel electric-weld line pipe is made to API 5L specifications, Grade A pipe. Both ends of each length (double-random lengths averaging 48 ft) are flared to receive a chill ring. This ring prevents welding metal from protruding into the pipe and damaging the cable during installation.

Inside the pipe was shot blasted and coated with rust resistant paint to protect it during shipping and installation. The outside was shot blasted and coated with coal tar enamel. The flared ends of the pipe were protected in transit by wooden plugs which sealed out foreign matter.

Cable is single conductor, 500 Mcm, 0.835-in. paper insulated, shielded, has D-shaped copper armor wire, and a temporary lead sheath. Fifteen lengths, three of which are spares, totalling 22,281 ft will be shipped.

Conductor is concentrically stranded with 61 strands of 0.0905-in., hard-drawn, bare copper. Two ⅝ and one ¾-in. metallized paper tapes over the conductor provide a smooth conducting surface, desirable in high-voltage cables to eliminate points of stress concentration. About 170 paper tapes, graded from 0.003 to 0.0065 in., are used with the thinner nearest the conductor to provide optimum impulse strength in this high-stress area.

Over the paper is 0.005-in. copper tape intercalated with 0.020 x ¾-in. woven cotton cloth tape. Overall is a 0.102-in. D-shaped copper armor wire applied in an open spiral. This armor protects the cable during installation, provides a low coefficient of friction, spaces cable to permit thermal oil circulation, and short-circuits turns of shielding tape.

During shipment and storage a temporary 0.078-in. plain lead sheath protects the cable. A crimped piano wire is laid under the lead to facilitate stripping when cable is pulled into pipe.

The potheads, 24 for use plus 3 spares, are of the double-tube design. An internal porcelain tube through which the cable passes to the upper terminal contains high-pressure oil. A porcelain weathershed provides mechanical protection of the internal tube and adequate external electrical characteristics (60-cps and impulse withstand voltages). The space between the porcelain tubes is filled with oil at atmospheric pressure. These potheads, made for Okonite by Ohio Brass, were designed for a 900-kv BIL and a test pressure of 500 psi.

CARL REEB, Chicago Branch Manager (right) receives 5 shares of Kerite stock from C. R. R. Harris, president of Kerite.

Kerite Celebrates 100th Anniversary

The Kerite Co, Seymour, Conn., celebrated its 100th anniversary by holding open house for employees, their friends, and industrialists of the community on June 10.

The plant was in full operation in the forenoon, allowing visitors to observe the many operations involved in manufacturing cable and to see their friends and relatives carry on the various operations. The history of the company was written for this occasion and distributed to employees and guests.

Mr C. R. R. Harris, president, presented 5 shares of Kerite stock to each of 8 employees with over 40 years of service.

Kaiser Aluminum Expands NW Mills

Kaiser Aluminum & Chemical Corp is installing two new rolling mills at the Trentwood works, near Spokane, Wash., at a cost of $1.5 million. A 3,000-fpm 60-in. four-high cold rolling mill for light-gauge sheet will increase sheet and plate capacity 36 million lb a year for a total capacity of nearly 400 million lb. A 72-in. embossing mill, to be in operation late this summer, will expand capacity for embossed sheet from 6 million to more than 18 million lb a year.

Henry J. Kaiser, president of the firm, said that further expansion of his Northwest operations would definitely depend on availability of power. The Northwest power situation is serious and nothing is being done about it. He added that in his belief the power development should be on some type of cooperative basis between the federal government and private concerns.

MANUFACTURING BRIEFS

Baldwin-Lima-Hamilton Corp has arranged to reacquire 515,000 shares of its common stock by purchase from Westinghouse Electric Corp for $4,635,000, or $9 a share. Withdrawal by Westinghouse from the manufacture of heavy electrical equipment for railroads permits the company to provide needed space for its basic apparatus lines. Future needs of Baldwin-Lima-Hamilton for electrical transportation equipment will be supplied by General Electric Co.

Line Material Co has completed a new 30,000 sq ft building at its Central Plant in South Milwaukee, Wis. This building will accommodate production of large products, such as metal enclosed capacitor banks. Building includes a 15-ton traveling crane, inside loading for boxcars and trucks, motor-driven windows, and 50 ft candle illumination.

Louthan Manufacturing Co, East Liverpool, Ohio, was purchased recently by Ferro Corp, Cleveland, Ohio, from Harbison-Walker Refractories Co, Pittsburgh, Pa. The Louthan Division will produce electrical porcelain insulators, refractory specialties, and other ceramic products. Harry T. Marks, administrative vice president of Ferro, will be the new president, and Charles W. Geister will be executive vice president and general manager.

B. C. Electric has placed a $1-million contract for an office building at Pandora and Blanshard St, Victoria, B. C. According to T. Ingledow, vice president and chief engineer, the six story glass and reinforced-concrete building will contain executive offices, electric and gas division headquarters, and auditorium and display facilities.

Worthington Corporation has moved its entire reciprocating power pump (except steam pump) operation from Harrison, N. J. to its Oil City Plant. Engineering, manufacturing, sales, and parts replacement programs are involved.

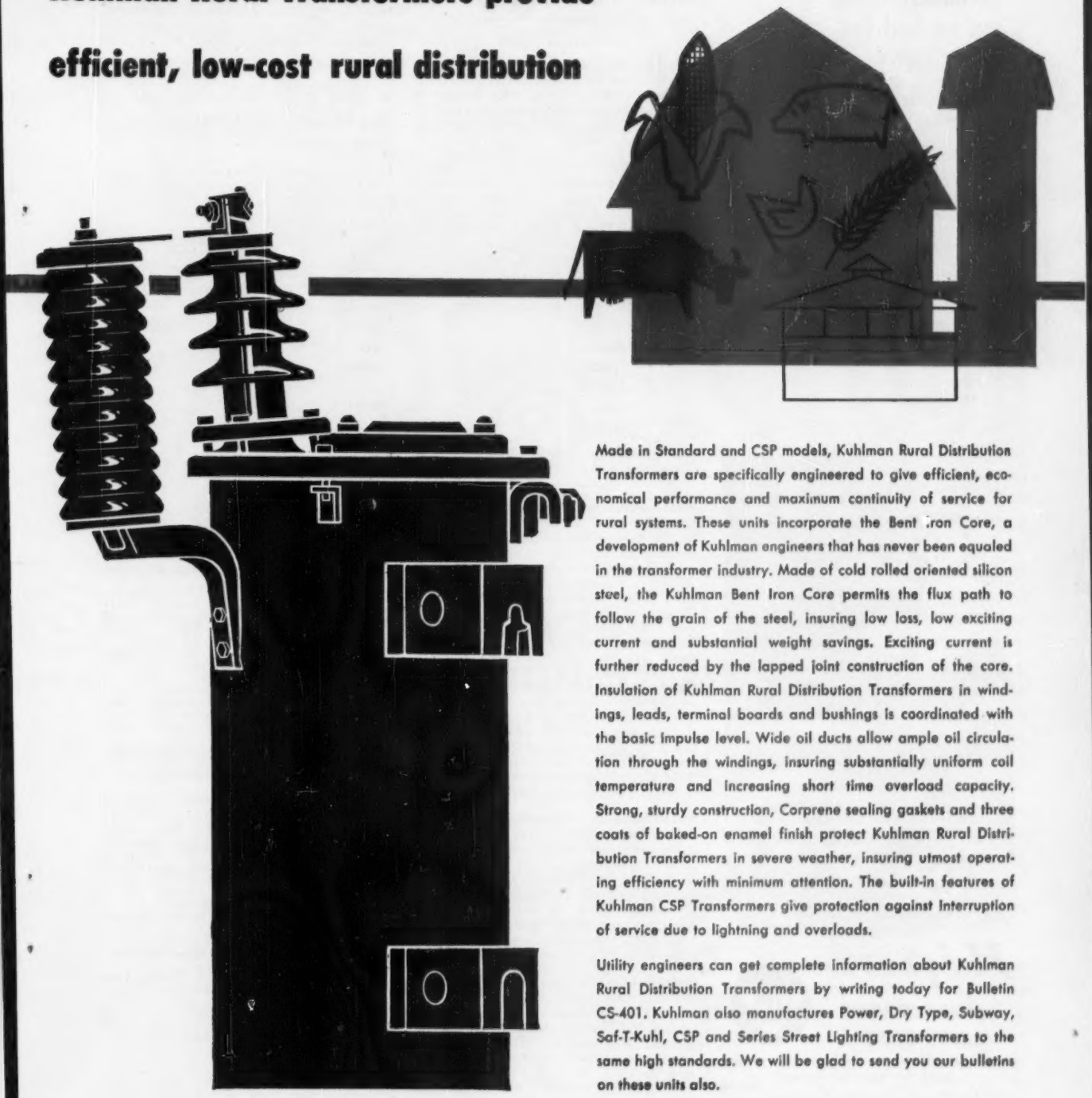
Underwriters' Laboratories, Inc has opened its fourth testing station, located at Northbrook, Ill. The new station, 45,000 sq ft of floor space on a 153-acre site, houses the Gas & Oil Dept, Burglary Protection Dept, and Extinguisher & Sprinkler Divisions of the Fire Protection Dept. About a third of the space will be used for office, storage, shipping, etc.

GE Ships 25-Million Kva Circuit Breaker

General Electric Co, Philadelphia, recently shipped a 330-kv circuit breaker to the Philip Sporn generating station at New Haven, West Virginia. This plant is owned and operated jointly by Ohio Power Co and Appalachian Electric Power Co of the American Gas and Electric System.

Built to interrupt 25 million kva, breaker will be installed on nation's first 330-kv transmission network. Completed breaker will weigh 83 ton and stand 25 ft high. General Electric plans to build 60 of these units.

Kuhlman Rural Transformers provide efficient, low-cost rural distribution



Made in Standard and CSP models, Kuhlman Rural Distribution Transformers are specifically engineered to give efficient, economical performance and maximum continuity of service for rural systems. These units incorporate the Bent Iron Core, a development of Kuhlman engineers that has never been equaled in the transformer industry. Made of cold rolled oriented silicon steel, the Kuhlman Bent Iron Core permits the flux path to follow the grain of the steel, insuring low loss, low exciting current and substantial weight savings. Exciting current is further reduced by the lapped joint construction of the core. Insulation of Kuhlman Rural Distribution Transformers in windings, leads, terminal boards and bushings is coordinated with the basic impulse level. Wide oil ducts allow ample oil circulation through the windings, insuring substantially uniform coil temperature and increasing short time overload capacity. Strong, sturdy construction, Corprene sealing gaskets and three coats of baked-on enamel finish protect Kuhlman Rural Distribution Transformers in severe weather, insuring utmost operating efficiency with minimum attention. The built-in features of Kuhlman CSP Transformers give protection against interruption of service due to lightning and overloads.

Utility engineers can get complete information about Kuhlman Rural Distribution Transformers by writing today for Bulletin CS-401. Kuhlman also manufactures Power, Dry Type, Subway, Saf-T-Kuhl, CSP and Series Street Lighting Transformers to the same high standards. We will be glad to send you our bulletins on these units also.

143-T

KUHLMAN

KUHLMAN ELECTRIC COMPANY, BAY CITY, MICHIGAN • Southern Division, CRYSTAL SPRINGS, MISSISSIPPI

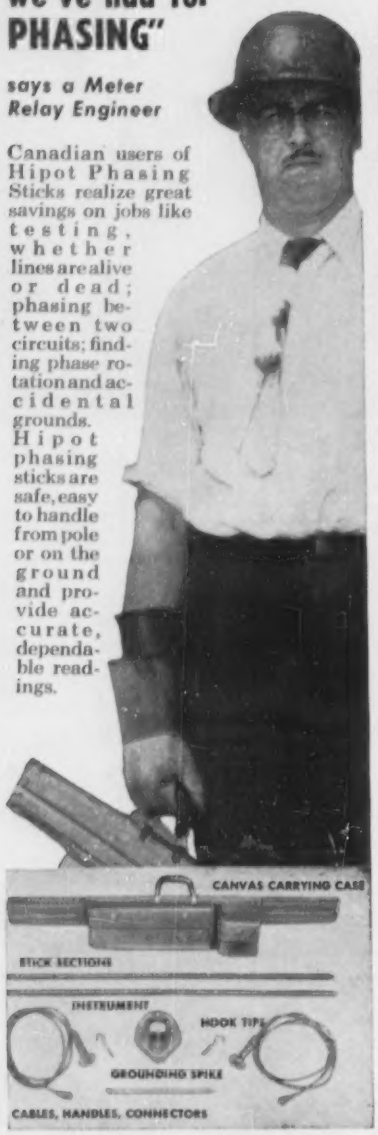
EXPORT REPRESENTATIVE: INTERNATIONAL STANDARD ELECTRIC CORP., 15TH FLOOR, 80 CHURCH STREET, N. Y. 7, N. Y. CABLE ADDRESS: MICROPHONE, N. Y.

SIXTY YEARS OF PROGRESS IN THE ELECTRICAL INDUSTRY

"Handiest thing we've had for PHASING"

says a Meter Relay Engineer

Canadian users of Hipot Phasing Sticks realize great savings on jobs like testing, whether lines are alive or dead; phasing between two circuits; finding phase rotation and accidental grounds. Hipot phasing sticks are safe, easy to handle from pole or on the ground and provide accurate, dependable readings.



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SALES ASSIGNMENTS

COMPANY STAFFS

Allen-Bradley Co, Milwaukee, has appointed John W. Mason district manager of its Detroit office. Mason, who became affiliated with the firm's Detroit office in 1952, succeeds J. Petersen, former district manager, who has retired.

Sylvania Electric Products, Inc, has promoted Clifton H. Emerson to sales manager of national accounts in the New England district for its Lighting Division with headquarters at Salem, Mass., and Walter H. Howard to the post of district sales manager in the same district, working out of Salem. Emerson formerly was district sales manager of the New England district and Howard formerly assistant district sales manager of the area.

Copperweld Steel Co has moved George Hamburger, manager of communication sales for the Wire and Cable Division, from his St. Louis headquarters to Washington, D. C., to direct communication sales throughout the U. S. Hamburger, who also represents the division in connection with government activities, once served as Copperweld's district sales manager in St. Louis.

Graybar Electric Co, New York, has appointed F. M. Sholders, manager of its Omaha branch for the past two years, to the post of district sales manager for the firm's Kansas City district, effective July 16. C. C. McGraw, manager of the Knoxville, Tenn., branch, replaces Sholders at Omaha. W. B. Owens, manager at Savannah, Ga., succeeds McGraw at Knoxville. Succeeding Owens at Savannah is L. L. Black, a Graybar salesman there since 1946.

Bailey Meter Co, Cleveland, has moved its Cincinnati district office to larger quarters at 2330 Victory Parkway. It is under the managership of R. M. Cundiff. The Cincinnati district territory includes southern Ohio, central and western sections of West Virginia, southwestern Virginia, Kentucky, and southeastern Indiana.

Allis-Chalmers Manufacturing Co's General Machinery Division has designated these four new district office managers: R. H. Porterfield, manager at Providence, R. I., goes to Hartford, Conn.; Aubrey Phillips, manager at Houston, takes over at Milwaukee; D. R. Boise, manager at Amarillo, transfers to Houston; and J. C. Lovelace, a representative at Amarillo, remains there in his new managerial post.

Hotpoint Co's Commercial Equipment Department has announced these appointments: District Manager Richard Ellis, who covered the Rockies and Southwest out of Dallas, takes over the Cincinnati territorial post vacated by the retirement of Jack Markham due to ill health. Colorado, Oklahoma and parts of Wyoming and New Mexico have been mapped out as a new zone under William Ramer, a former employee of Potomac Edison Co. Paul M. Markavage, formerly Philadelphia district commercial specialist for Graybar Electric Co, takes charge of the new zone covering the District of Columbia and Virginia.

American Steel & Wire Division of U. S. Steel Corp has named Frank T. Clarke as manager of sales of its district sales office in Boston. Clarke, formerly manager of manufacturers' products in New York, succeeds A. N. Murdock, who retired recently.

Reliance Electric & Engineering Co, Cleveland, has assigned William C. Prettyman to the sales application engineering staff of its New York office. An electrical engineer, he formerly served the firm in Chicago.

MEETINGS CALENDAR

Michigan Electrical Association
Annual Convention, Grand Hotel, Mackinac Island, Mich., June 27-30.

Edison Electric Institute
Accident Prevention Committee, Mark Hopkins Hotel, San Francisco, July 1-3; Accident Prevention Committee, Benjamin Franklin Hotel, Philadelphia, Sept. 20-21; Industrial Relations Committee, Round Table Conference, Palmer House, Chicago, Sept. 27-29; Prime Movers Committee, De Witt Clinton Hotel, Albany, N. Y., Oct. 4-5; Electrical Equipment Committee, Hotel Statler, Hartford, Conn., Oct. 11-12; Prime Movers Committee, Astor Hotel, New York, Nov. 29-30.

Northwest Electric Light & Power Association
Personnel Section with EEI Industrial Relations Committee, Multnomah Hotel, Portland, Ore., July 12-14.

World Power Conference
Sectional Meeting, Rio de Janeiro, Brazil, July 25-Aug. 10.

Pan-American Federation of Engineering Societies
(UPADI), Third Convention, Sao Paulo, Brazil, Aug. 2-12.

***American Society of Mechanical Engineers**
Fall Meeting, Schroeder Hotel, Milwaukee, Sept. 8-10; Annual Meeting, Statler Hotel, New York, Nov. 28-Dec. 3.

***Rocky Mountain Electrical League**
Annual Fall Convention, Stanley Hotel, Estes Park, Colo., Sept. 12-15.

Illuminating Engineering Society
National Technical Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., Sept. 12-16.

Public Utilities Association of Virginias
Annual Meeting, Greenbrier, White Sulphur Springs, W. Va., Sept. 16-18.

American Institute of Electrical Engineers
Committee on Petroleum, Conference on Electrical Applications in Petroleum Industry, Mayo Hotel, Tulsa, Okla., Sept. 27-29; Middle Eastern District Meeting, Abraham Lincoln Hotel, Reading, Pa., Oct. 5-7; Fall General Meeting, Morrison Hotel, Chicago, Oct. 11-15.

National Electronics Conference
10th Annual Conference, Hotel Sherman, Chicago, Oct. 4-6.

National Association of Electrical Distributors
Pacific Zone Convention, Mark Hopkins Hotel, San Francisco, Oct. 4-7.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., Oct. 6-8.

Interstate Power Club
Meetings will be held at Hotel Martinique, New York, on following dates: Oct. 11, Dec. 6.

***Pennsylvania Electric Association**
Fall Meeting, Electrical Equipment Committee, Hotel Robert Treat, Newark, N. J., Oct. 19-20.

Public Information Program
Workshop Conference, Chase Park Plaza Hotel, St. Louis, Oct. 28-29.

National Electrical Manufacturers Association
Haddon Hall Hotel, Atlantic City, N. J., Nov. 8-11.

***Addition this week.**

Crepe paper applied on one leg of 27 K.V. — 3 conductor — 500 M.C.M. paper insulated, gas filled cable.

Oil-immersed Varnished Cambric applied on 27 K.V. — 3 conductor — 500 M.C.M. paper and lead solid type cable.

Select your insulating tapes from the complete Irvington line

For gas-filled cable, use Irvington vacuum treated, oil impregnated Crepe Paper No. 4000 — packaged in cans to meet your specific requirements for number and size of rolls. *Whenever* your needs for crepe paper are not fully met by packaged splicing kits, make Irvington your source of supply.

For oil-filled cable, use No. 5000 Yellow or No. 5500 Black Low Loss Varnished Cloth Tape — both packaged under vacuum. Or if you prefer, choose No. 6000 Yellow or No. 6500 Black Oil Immersed Varnished Cloth Tape.

OTHER IRVINGTON PRODUCTS FOR UTILITIES: *For moisture-proof, oil-tight cable splices and stop joints* on rubber, paper or cambric insulated cable, use No. 621 Harvel Oil Stop. *And for an oilproofing finishing coat* over bus bar wrappings — or for sealing pipeline joints and gaskets — apply No. 32 Red Enamel.

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"LC"—Line Construction Bodies with or without crew compartments. Fabricated for rugged use. Designed for efficient tool and parts storage and built to a high standard.

"CMS"—Combination Meter Service Bodies 74" to 104" long by 74" to 89" wide. Transverse through compartment at front of body for carrying electric or gas meters. Capacity 12 to 36 electric meters or 5 to 16 gas meters. Two small parts drawers with removable dividers.

"SML"—Service Maintenance Ladder Bodies built to carry a ladder of your specifications. Complete with warning system and flashing lights. Compartment installations the same as "SM" Series Bodies.

"PLCC"—Combination Platform and Line Body with crew cab. Bodies of many different custom designs with or without crew cabs. Increases utility use of platform bodies with or without diggers.

"TT"—Transformer Trailer is one design of many for installation of transformer and circuit power. Transformer Trailers provide added capacity to restore service when secondary breakers trip repeatedly or transformers overload. This ingenious arrangement simplifies change-outs with fast service, anywhere.

"CPT"—Cargo Pole Trailers of many designs and capacities. Single, dual and four wheel trailers built to your specifications.

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BOOKS

Received Since June 1

Government and Science: Their Dynamic Relation in American Democracy By Don K. Price. Published by New York University Press, New York 3. 203 pages. Price $3.75

Transient Analysis of Alternating Current Machinery. By Waldo V. Lyon. Published by John Wiley & Sons, Inc, New York 16. 310 pages, illustrated. Price $7.00

Acoustics. By Leo L. Beranek. Published by McGraw-Hill Book Co, New York 36. 481 pages, illustrated. Price $9.00

Ferromagnetic Domains. By K. H. Stewart. Published by Cambridge University Press, New York 22. 176 pages, illustrated. Price $4.75

Waves

Elektromagnetische Wellen. By K. W. Wagner. Published by Verlag Birkhauser, Basel, Switzerland. 267 pages, illustrated. Price (bound) Francs 33.30 (Printed in German)

Comprehensive mathematical development of electromagnetic waves comprises the subject matter. It deals first with waves in free space along with reflection and distortion, next with waves in conductors, in hollow conductors and finally in the ionosphere. Power engineers with a communication leaning will be more interested than the orthodox 60-cycle engineers. The brief index is confined to key words.

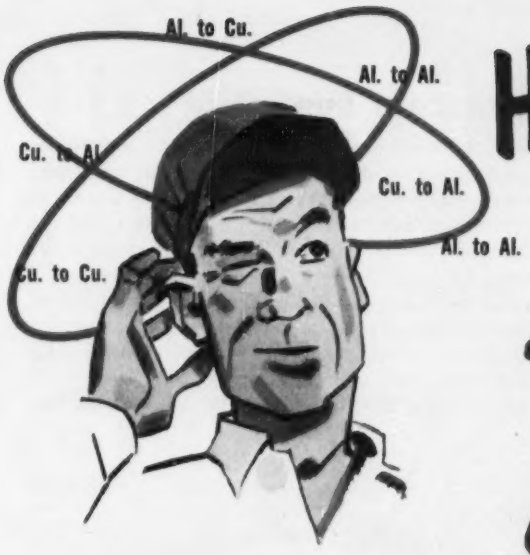
Welded Bridges

Comparative Bridge Designs. Edited by James G. Clark. Published by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. 211 pages, illustrated. Price, $2.00 in U. S., $2.50 elsewhere.

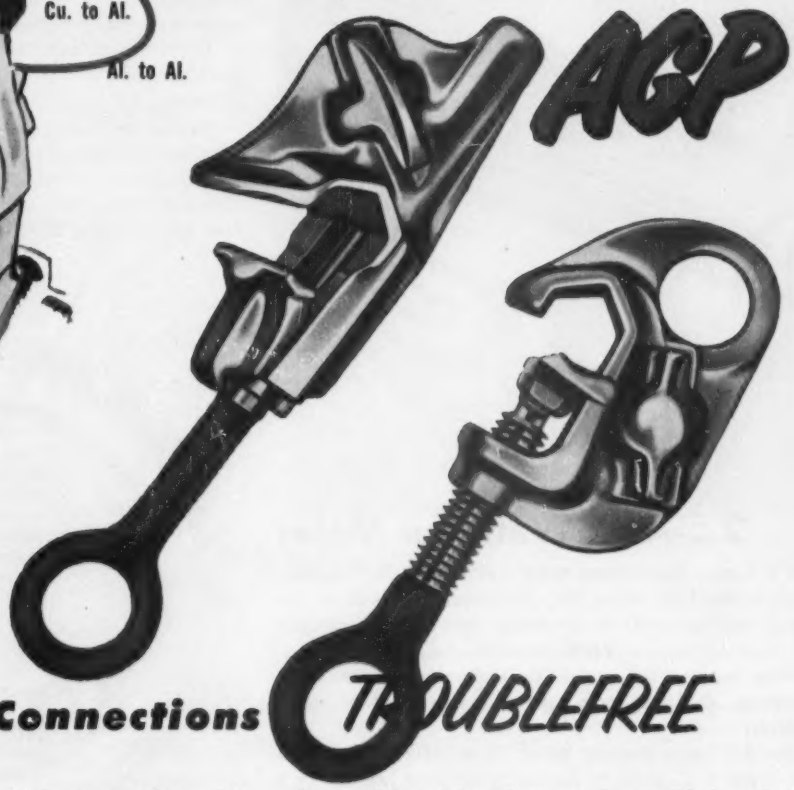
This book presents designs by leading bridge designers in the United States to illustrate how significant savings in material and money can be achieved through the use of welding. Material presented in the book covers designs entered in a recent award program sponsored by the Foundation.

Shown are welded designs of comparable riveted bridges, either existing or proposed. In order to cover as many types of bridges as possible, editor Clark has selected important details from the outstanding entries in the award program and compares details of the welded and riveted designs. The original designers' comments are included to explain how the welded designs realize important savings in material and time.

Major types of bridges in varying lengths are studied—continuous girder bridges, with and without floor beams; prestressed girder bridges; simple beam spans; simple trusses; continuous trusses; arches. Major design elements from a number of bridges of each type are described. Original drawings by the designers are reproduced in legible two-page size, along with the designers' discussions and descriptions.



Here's the solution!



Keeps Tap Connections TROUBLEFREE

Chance AGP Tap Clamps, the first successful multi-purpose clamps, solve today's tap connection headaches. AGP Clamps can be used successfully with Aluminum to Copper, Aluminum to Aluminum, Copper to Aluminum, or Copper to Copper. That's because they are given a *properly applied coating* of high-density, fortified cadmium—to a thickness of .001". Tests undertaken by conductor manufacturers and several large power companies ... and actual field service, all prove that Chance cadmium coating resists corrosion and electrolysis in all types of connections.

Heat treated aluminum alloy bodies are light in weight. This makes them easy to handle on a clamp stick and lengthens conductor life by minimizing the effect of vibration.

Contacts stay tight—the thermal expansion of the clamp is uniform with aluminum conductor ... and since the thermal coefficient of copper is less than that of aluminum, the clamp will not deform copper conductor even under extreme temperature variations. The conductor is protected at all times.

Specify Chance AGP Clamps to solve your tap connection problems. They will eliminate the possibility of error in connector applications—reduce inventories—and greatly simplify your stocking problems. AGP Clamps are available in both the Protected Connection (PC) and Perma-Grip designs.

* **CHANCE *Aluminum General Purpose – the Tap Clamp with the RED Eye Screw.***

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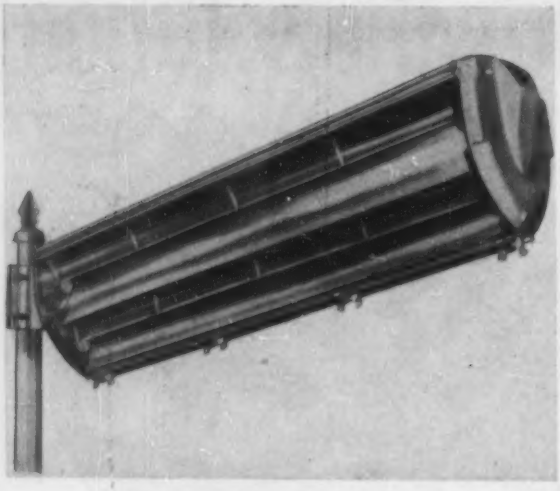
NEW EQUIPMENT

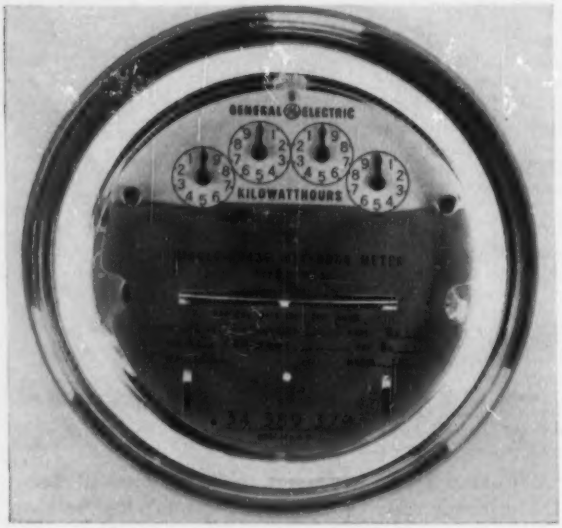


Fluorescent Luminaire

Four-lamp fluorescent luminaire for street lighting systems is designed for mounting at 25 ft or higher. Luminaire accommodates 6-ft lamps and approaches a Type III or IV distribution pattern. Brightness level is 1/20th the level of small-source luminaires having similar light distribution.

Metallic parts are cast or sheet aluminum. Covers are translucent plastic, hinged at top and latched at bottom. Gaskets make luminaire weather- and bug-proof. Bracket allows ±5 deg leveling and 20 deg tilt.

Line Material Co, 700 W. Michigan St, Milawaukee, Wis.



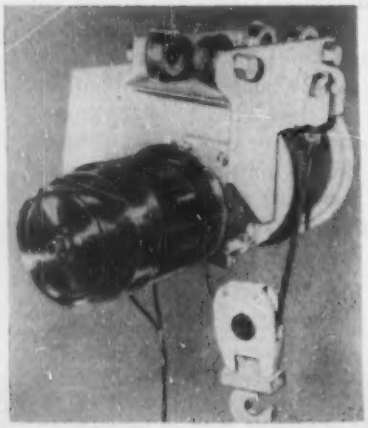
2.5-Amp Watthour Meter

A 2.5-amp, transformer-rated watthour meter has been added to the I-50 meter line. In conjunction with proper current and potential transformers, unit provides straight-line accuracy over a 400% metering range.

Meter is rated 120 or 240 v, single phase. Detachable nameplate allows changing multipliers without replacing registers.

Also a 2.5-amp demand meter, Type IM-50, is available with either a Type M-30 indicating demand register or a Type M-31 cumulative demand register.

General Electric Co, 1 River Rd, Schenectady 5, N. Y.



Hoists

Standard models of 4, 5, and 6-ton capacity electric hoists for overhead materials handling have wire rope lift, with swivel hook suspended on a 2-part line. Suspension is by lug, hook, plain or geared trolley.

Hoists are all-steel, welded construction with their electrical components protected for outdoor, year around operation. Motors and gear reduction units are adapted from the company's present line.

Bi-metallic friction brake and instantly-applied maximum motor torque give positive load control to a fraction of an inch. Two-button control box is suspended directly beneath hoist.

Single-speed, reversible squirrel cage motors operate on 220 or 440 v, 3-phase current.

Materials handling products are a new line for LeTourneau. Special attention will be given to lifts of over 15 tons. Other products will include 360 deg jib cranes, floating gantry crane, 20-ton mobile jackknife crane, and a 25-ton revolving crane.

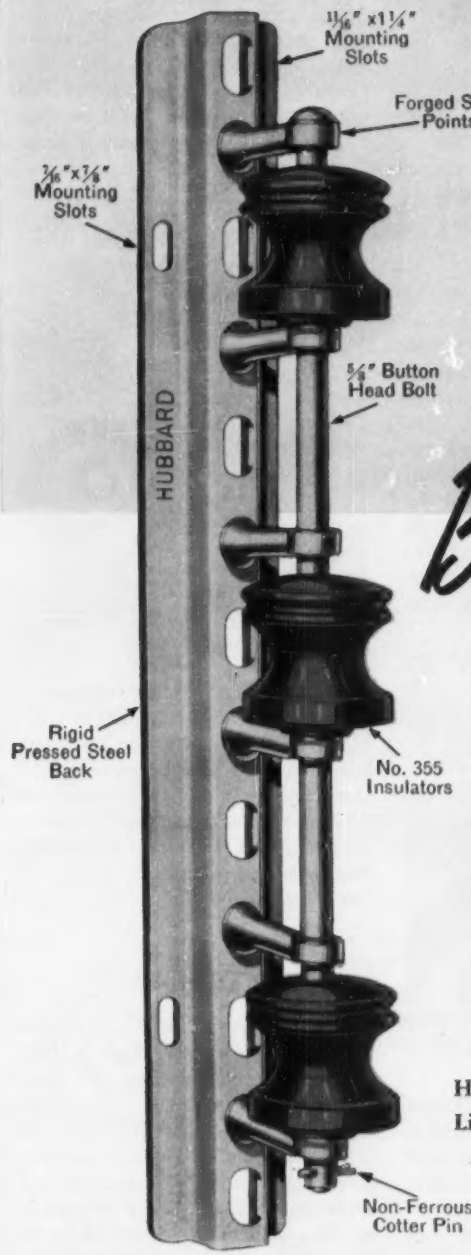
R. G. LeTourneau, Inc, Longview, Texas

Insulated ACSR Splice

Insulated splice for ACSR is used for series street lighting or other applications where a run is to be interrupted or terminated. They are constructed like two straight-through dead-end units attached to an insulating section of strong, tough glass Melamine. Claimed tensile strength is 1,800 to 3,500 lb.

Laboratory tests show a dry flashover of 55.5 to 58.0 kv; fog flashover of 17.5 to 47.0 kv; and rain flashover of 20.0 to 33.0 kv. Report states that

Linemen Like the HUB-RAK



No. 30648

Because....

- The design gives extra strength without extra weight.
- Mounting slots are located to give wide choice of mounting bolt location for easy installation.
- The points are firmly riveted and perfectly aligned for quick insertion of rack bolts.
- Smoothly finished, smoothly rotating insulators make easy work of pulling in the lines.
- Broken insulators are readily replaced.
- Strong construction and double dip hot galvanizing prolong life and reduce replacement to a minimum.

Hubbard Secondary Racks are made in Heavy, Medium, and Light Types, to conform to E.E.I. standard specifications.

This popular size, in non-extended back, is also available in Heat Treated, Solid Aluminum Alloy.

Write for detailed information

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"Hang the Load on Hubbard Hardware!"

Just Published!

TRANSIENT ANALYSIS OF ALTERNATING CURRENT MACHINERY

An Application of the Method of Symmetrical Components

By WALDO V. LYON

Professor Emeritus of Electrical Machinery
The Massachusetts Institute of Technology

The product of more than twelve years of research and study, this is the first book to apply Fortescue's method of symmetrical components to the solution of *transient* conditions in A-C machinery.

The method has long been an indispensable tool in the analysis of the unbalanced operation of polyphase machines and their connected networks. Its applications, however, have been confined to the steady-state behavior of machines. The resolution into symmetrical components has involved the complex representation of alternating currents and potentials and the system constants. Though Fortescue was aware that his method of resolution could also be applied to the instantaneous values of currents and potentials, there has never until now been a systematic development of this phase of the analysis.

Offering an analysis founded on the Kirchhoff differential equations that apply to the machine and connected system, Professor Lyon shows how Fortescue's method can be used to determine the transient behavior of polyphase machines under different operating conditions. Of great interest to all concerned with the design and operation of A-C machines and their connected circuits, his book fills an important place in the complete library of electrical technology.

1954 310 pages Illustrated $7.00

Co-published by John Wiley & Sons, Inc., and the Technology Press of the Massachusetts Institute of Technology

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Please send me for FREE examination a copy of Lyon's *Transient Analysis of Alternating Current Machinery*. Within ten days I will either return the book and owe you nothing or will remit $7.00, plus postage.

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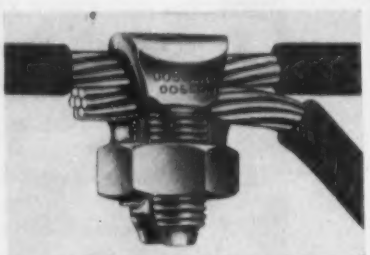
EW-64

no carbonization of insulation occurred during test period. Splices are made for 4 6/1 and 4 7/1 ACSR.
Reliable Electric Co, 3145 Carroll Ave, Chicago 12, Ill.

Ground Rod

Sectional ground rod enables deeper grounding to give lower earth-to-rod resistance, giving better protection to expensive overhead apparatus. Steel core of rod is completely covered with a uniform bonded copper sheath. Bronze couplings fit all standard sectional rods. Rods are ½, ⅝, or ¾ in. dia and 8 or 10 ft long. Any number of rods may be coupled to reach permanently moist soil. Driving studs are heat-treated steel.
Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.



Connector

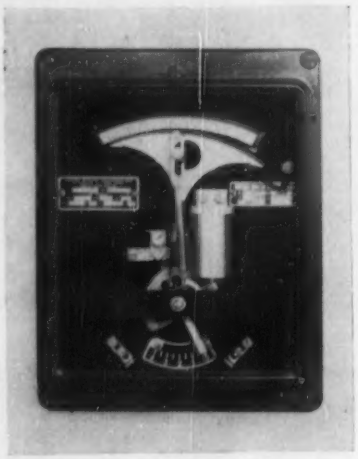
Split-bolt service connector, Dosson F, is completely cold formed. Strength is claimed equivalent to mild steels. Connector is available in sizes for AWG 14 to 1/0 conductors.
Dossert Manufacturing Corp, 249 Huron St, Brooklyn 22, N. Y.

Voltage Regulator

Generator voltage regulator, Universal Model JSG 1/1, is self-contained and factory sealed. By jumpering at external terminals on back of unit, it will regulate any 25 to 250 kva generator. Guaranteed sensitivity is 1.5%. No auxiliary equipment is required for operation.

Regulation of voltage uses a rocking contact and commutator-type contact track, which consists of 50 silver-plated contact segments wrapped in mica sheet, wedged and doweled into a bronze frame. Main and auxiliary shafts are supported by pairs of floating, cup-type sapphire jewel bearings.

Unit will regulate standard gener-



ators with rated exciter voltage of 80 to 125 v, 50-60 cps, 1,200 to 1,800 rpm. Regulating resistance has 5 taps brought out to external terminals. A paralleling resistor may be connected to various taps to decrease variously the total value. Literature is available.
Brown Boveri Corp, 19 Rector St, New York 6, N. Y.

1,250-HP Motor

A 1,250-hp, 2,300-v, 1,780-rpm explosion-proof motor, Type ANZZ, has been developed from the company's totally-enclosed, fan-cooled motor line with tube-type air-to-air heat exchangers. It has received Underwriters' Laboratories approval for operation in Class I, Group D hazardous locations. This is claimed to be the largest machine of its kind approved by the Underwriters' Laboratories.

Approval extends to motors of this size, similar construction ,and equivalent frames in which the internal free volume and physical dimensions do not exceed that of the motor tested.
Allis-Chalmers Manufacturing Co, 930 S. 70 St, Milwaukee 1, Wis.

FARGO Time Savers...

A Connector That's *All in One-Piece*

"5000 Series"

Fargo Connectors are built like a vise . . . grip like a vise—and hold wires *permanently!* They make a vibration-proof contact . . . require no attention after installation—and provide an ideal, low-resistance connection. The one-piece construction of Fargo Connectors makes them easier to handle . . . safer to use. Also, they are made with a *completely enclosed thread* so they can be readily salvaged for re-use.

An Automatic Line Splice *That Requires No Tools*

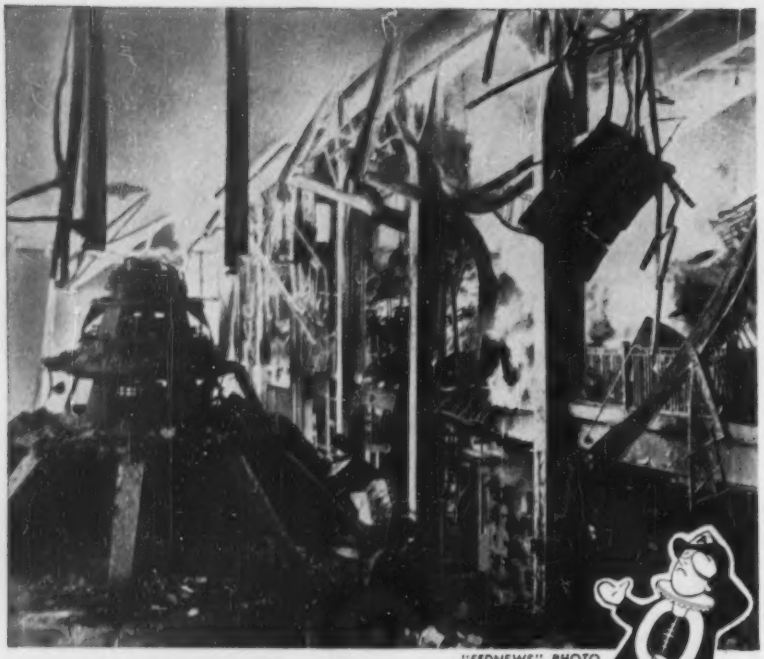
"LS Series"

Fargo's exclusive one-piece jaw construction makes for the greater strength and permanence inherent in all Fargo Automatic Line Splices. They are easily, quickly and safely installed without tools. And, on both new construction and maintenance, their overall installed cost is low.

FARGO

LM®

Ask your Line Material Field Engineer for complete details.



"FEDNEWS" PHOTO

Let There Be Light-

Sorry — we're out of business today, and for many days. We've been forced to cut "interruptable" customers. Total loss in fire damage and power may exceed 10 million dollars.

Here's what happened. Fire started in a circuit breaker and spread throughout the building. The roof crashed down. Giant steel beams sagged like ribbons. Concrete walls fell into the machinery. Engineers and repair crews are restoring our power output, but it will take time and plenty of money.

Moral: Prevent damage to equipment and interruption of power service with ENGINEERED "Automatic" FIRE PROTECTION. It involves analyses of your needs based on the machinery and equipment connected with your operation. Your hazard may best be protected by means of "Automatic" FIRE-FOG, AIR FOAM, CO_2 or a combination of these extinguishing mediums. The need is dictated by the degree of hazard, the demand for personnel safety, the high value of equipment, the requirements for uninterrupted business operations.

Learn how ENGINEERED "Automatic" FIRE PROTECTION can safeguard your plant — save you dollars while doing it. Mail the coupon for FREE descriptive literature.

"Automatic" Sprinkler Corp. of Amer.
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Please rush copy of Bulletin 64 — Design and Application of "Automatic" FIRE-FOG

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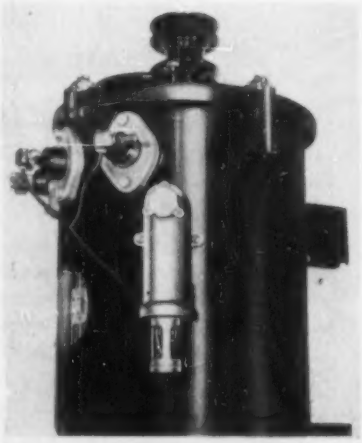
"Automatic" Sprinkler
CORPORATION OF AMERICA
YOUNGSTOWN, OHIO
Offices in principal cities of North and South America

Line Traps

Line traps, Type M, are rated 400 and 800 amp. Molded design provides a lightweight trap capable of withstanding mechanical forces during faults. Tuning units available permit tuning to standardized channels in 30-200 kc range. Tuning is accomplished without removing tuning units. The original series of traps were designed for 1,200 amp.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



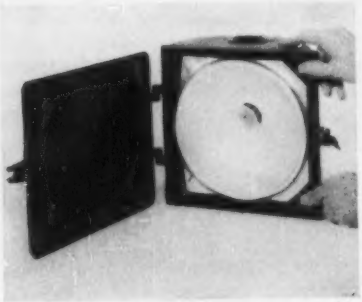
Overload Indicator

Accurate, ambient-compensated transformer-overload indicator provides visible indication of overload by means of a drop-down red light or a drop-down luminescent tube. Unit indicates an overload when transformer winding hot-spot temperature reaches approximately 95C.

Indicator consists of a tank-wall heat receiver and an ambient temperature receiver mounted in a moulded phenolic-resin housing. When the red-

light indicator is used, a 2-conductor cable is furnished for connection to the 120-v transformer terminals. Cable has 18,000-v BIL; indicator has same BIL as transformer secondary. Indicator may be installed on transformers in service or factory-mounted on new transformers.

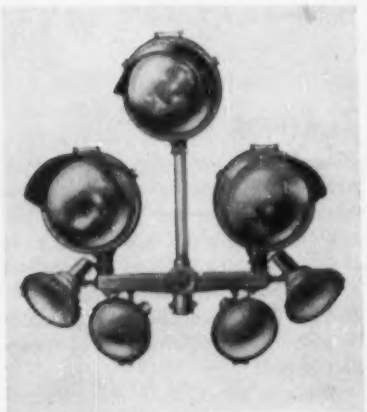
Line Material Co, 700 W. Michigan St, Milwaukee 1, Wis.



Traffic Signal

Adjustable traffic signal is engineered to reduce breakage and improve optical efficiency, and meets specifications of Institute of Traffic Engineers. Design reduces "sun phantom," an apparent signal due to sunshine. Fixed-focus type socket may be rotated to orient lamp to place filament in "open-end up" position for effective utilization of light output.

General Electric Co, 1 River Rd., Schenectady 5, N. Y.



Floodlights

One-pole floodlight assembly serves a wide range of industrial and commercial applications. The cast-aluminum crossarm bracket (Type GPT)

No. 4 in a series discussing why ASCO means adequacy in Automatic Transfer Switches

...Why is instantaneous arc interruption vital in Automatic Transfer Switch operation?

NORMALLY in single throw devices such as motor starters, arc interruption time is not a basic design consideration, except incidentally as reflected by tolerable contact erosion for a specified number of operations.

But...

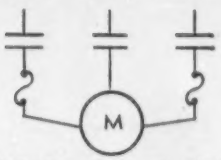
IF TWO such devices are combined to form a Transfer Switch, *time becomes a vital factor.* Upon reduction or loss of normal voltage, your Switch must transfer connected load to an emergency source of the proper voltage and frequency. To provide continuity of light and power, this transfer must take place almost instantaneously.

Arc interruption must be correspondingly rapid; the arc must be extinguished on one Switch before contacts close on the other in order to prevent a short circuit from system to system.

Ordinarily, on transfer to emergency, the current interrupted is relatively small. However, upon retransfer to normal, the Switch *must always interrupt maximum current and voltage.* Furthermore, failure of the detecting relay coil supervising the normal source will mean maximum current and voltage must be interrupted on normal source contacts as well.

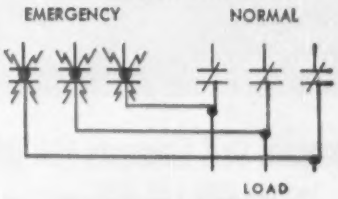
Even on two A-C three phase systems, out of phase conditions occur so that paralleling the systems without causing excessive current flow is impossible.

SINGLE THROW DEVICE



(Arcing time relatively unimportant)

TRANSFER SWITCH



UNEXTINGUISHED ARC SHORTS TWO POWER SYSTEMS

ASCO AUTOMATIC TRANSFER SWITCHES TRANSFER CONNECTED LOAD IN 2 to 10 CYCLES!

ASCO TRANSFER TIME IN CYCLES (60 CYCLE BASIS)

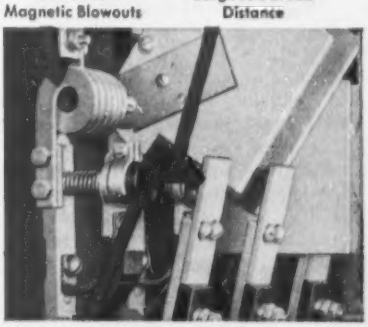
Amp. Rating	Normal to Emergency	Emergency to Normal
30	3	2
75	4	3
150	4	3
200	8	5
300	8	5
400	8	5
600	9	6
800	10	7
1000	10	7

IN OPERATION the separate arcing contacts guide the arc into an insulated chamber. Here a powerful transverse magnetic field, causing immediate arc disruption, is provided by current type magnetic blowout coils. With these coils, the strength of the magnetic field increases with the current, thus providing increasing arc disrupting ability.

Wide arc break distances further insure prompt disruption of the arc.

Powerful Magnetic Blowouts

Large Arc-Break Distance



Floating Arcing Contacts

"ASCO Engineered" Automatic Transfer Switch with Circuit Breaker Construction One Arc Chute Removed

For further information on Automatic Transfer Switches send for reprints of the first three ads in this series and for Publication 502, explaining how to select this equipment.

ASCO Solenoid VALVES

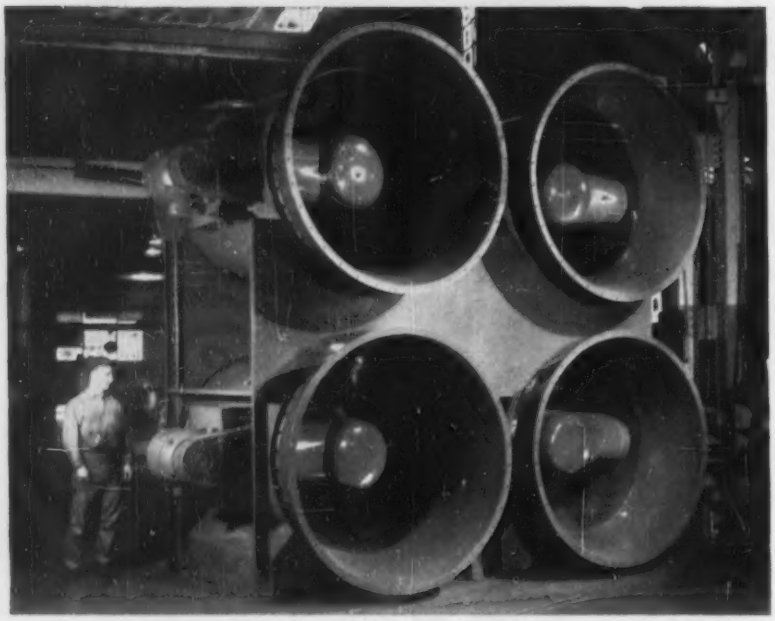
Automatic Switch Co.

397 LAKESIDE AVENUE ORANGE, NEW JERSEY

ASCO Electro-Magnetic CONTROLS

excess

TAKING THE ∧ HEAT OFF THE POWER PLANT!

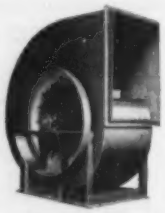


Compact Unit Exhausts 180,000 CFM from Large Power Plant

This "Buffalo" Unit in a prominent eastern power plant building is made up of four 54" Type "B" Vaneaxial Fans, each handling 45,000 cfm at 1¼" static. Size of unit is 15' x 12' x 8' thick including motors and drives, and is suited for use in existing buildings. You can install "Buffalo" Axial Flow Fans in minimum space for high-efficiency, high-velocity cooling action. Full range of sizes. Write for Bulletin 3533-C.

A "Buffalo" UNIT FOR YOUR COMFORT COOLING JOB!

"Buffalo" Type "BL" Limit-Load Ventilating Fans offer you a range of 1000 cfm to 500,000 cfm in exceptionally quiet, efficient, stable delivery for ventilation and air conditioning supply — described in Bulletin F-100. "Buffalo" also builds Heavy-Duty "NV" Propeller Fans in capacities from 5,000 to 150,000 cfm, as well as a complete line of Air Cleaning and Air Cooling Equipment. Write us today for literature on comfort cooling for your power plant!



Type "BL" Fan

Air Washer

"Buffalo"

BUFFALO FORGE COMPANY

212 MORTIMER ST. BUFFALO, N. Y.

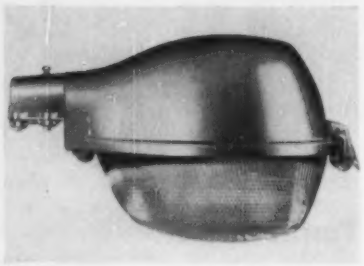
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT FORCED DRAFT
COOLING HEATING PRESSURE BLOWING EXHAUSTING

slip-fits 2-in. pipe. Top of bracket will take two MDB-14 fixtures. End and bottom are tapped ½-in. for four MDB-10 floodlights. A vertical 1½-in. pipe may be added to accommodate a third MDB-14.

General purpose floodlight, Type MDB-10, is also available with flat base mounting and cord and plug for ground locations. Fixture takes 200 or 300-w bulbs. The MDB-14 will take a 500-w lamp. Bulletin 386-F. **Crouse-Hinds Co, Wolf & Seventh North St, Syracuse, N. Y.**



Luminaire

Luminaire for multiple or series ballasted mercury vapor systems accommodates horizontal mounting of C-H5, A-H1, E-H1, and J-H1 lamps and provides a Type III distribution pattern. This Ovalite luminaire will also accommodate incandescent lamps up to 15,000 lumens. Lamp positions are adjustable. Cast aluminum hood houses Alzak-treated aluminum reflector and supports hinged refractor. **Line Material Co, 700 W. Michigan St, Milwaukee 1, Wis.**

21-Frame Motor

Mounting versatility and shaft rigidity are features of shaded-pole fractional-horsepower motor. The KSP 21-frame motor has a ½-in. rigid shaft for long single- and double-shaft drives. Shaft-height base is 3½ or 2⅝ in. Leads are 20-in. long. Lightweight die-cast aluminum construction is used.

Motor is available in end-mounted or resilient-base, open and totally-enclosed fan-cooled models; 1,550-rpm, 4-pole 60-cps ratings of 15-mhp to 1/10 hp; and 1,050-rpm, 6-pole, 60-cps rating of 25-mhp to 1/10 hp. **General Electric Co, 1 River Rd, Schenectady 5, N. Y.**

MORE NEW PRODUCTS
about which you should know

Ilsco Copper Tube & Products, Inc, Mariemont Ave, Cincinnati 27, Ohio has Type MU **connector** for 2 conductors. The MU250 is for 250Mcm to No. 6 wire; MU350 for 350Mcm-4; and MU600 for 600Mcm-4/0 wire. Connector is made from copper tubing.

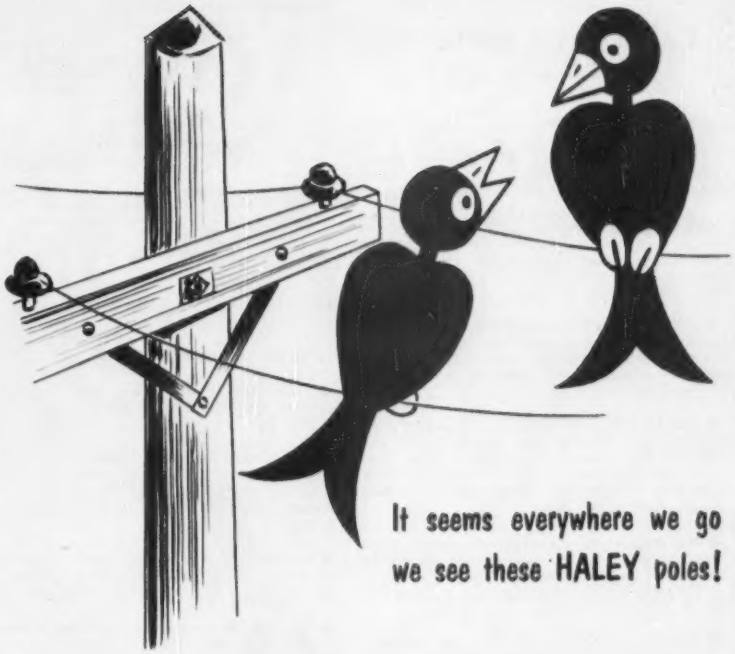
Associated Research, Inc, 3758 W. Belmont Ave, Chicago 18, Ill. has Model 250 Vibrotest **insulation tester,** rated 1-50,000 megohm in 4 ranges at 500-v dc test potential, 115 v ac input (Bulletin 2-2) . . . Auto-Test, Inc, 600 S. Michigan Ave, Chicago 5, Ill. has snap-around **dc ammeter** and voltmeter, rated 0-45-450 amp, 0-10-20 v dc.

Brush Electronics Co, 3405 Perkins Ave, Cleveland 14, Ohio has multichannel **oscillographs,** direct writing, 4 or 6 channels, 1-250 mm/sec . . . Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia, Pa. has a line of **chart paper** and **recording inks** for faster recording speeds.

Industrial Development Laboratories, 17 Pollock Ave, Jersey City, N. J. has neon-lamp type **test instrument,** Model R-10, measures 5 ohms to 50 megohms in a bridge circuit, 115 v ac input . . . Standard Electrical Products Co, 2240 E. Third St, Dayton Ohio has **electric etcher** for marking tools, etc, Model E-154, ac input.

Federal Electric Products Co, 1429 Park St, Hartford, Conn. has Type AB molded-case **circuit breakers,** 15-600 amp, 600 v, in NE, NF, NK, and WL frames . . . Pyle-National Co, 1334 N. Kostner Ave, Chicago 51, Ill. has Series CT **liquid-tight connector** for Sealtight flexible conduit, straight, 45, or 90 deg, ⅜ to 2 in.

Barmotive Products, Inc, 440 Peralta Ave, San Leandro, Calif., has **portable barrier** (Safe-T-Bar) consisting of A-leg assemblies, single legs, and sign-frame assemblies between legs . . . Gilbreth Co, 1211 Chestnut St, Philadelphia, Pa., has pressure-sensitive **adhesive** for Teflon, Mylar, silicone-glass laminates, polyethylene, and polyester films.



It seems everywhere we go we see these HALEY poles!

Haley's PENTAchlorophenol TREATED

CEDAR POLES
AND
FIR CROSS ARMS

Light in weight and clean. PENTAchlorophenol treated in our modern plant for protection against decay, moisture and insect damage.

TWO Strategically Located Yards
MINNEAPOLIS, MINNESOTA
FINDLAY, OHIO

R. G. HALEY & CO.
SPITZER BLDG. TOLEDO 4, OHIO

CATALOGS • BULLETINS

● **TESTERS:** Bulletin 22, 4 pages, covers 40 kv dielectric test set. Bulletin 80 (folder) covers motor rotation and phase tester. James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

● **HP SOLENOID VALVES:** Bulletin HP201, 4 pages, covers solenoid valves for 5,000 psi at 150F, 2,500 psi at 450F. Atkomatic Valve Co, Inc, 545 W. Abbott St, Indianapolis 25, Ind.

● **HEAT EXCHANGER TUBES:** A 24-page booklet covers uses and specifications of aluminum heat-exchanger tubes. Aluminum Company of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

● **IONIC AIR CLEANER:** A 6-page folder shows the Precipitron electrostatic air cleaner for homes, rated for 90% dust removal, 1,000-2,400 cfm. Westinghouse Electric Corp, 200 Readville St, Hyde Park, Boston 36, Mass.

● **Hg RELAYS:** Catalog 154 covers mercury plunger-type relays rated up to 60 amp, 115 v ac. Ebert Electronics Corp, 212-216 Jamaica Ave, Queens Village 28, N. Y.

● **WATER GAGES:** A 20-page catalog, Bulletin WG-1812(54), covers water gages for boiler pressures to 2,500 psi. Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

● **GE BULLETINS:** Following are available from General Electric Co, 1 River Rd., Schenectady 5, N. Y.:

GEA-6119 Water Systems Control, domestic, pressure and sump-pump switches—6 pages.

GEA-6127 Packaged Speed Variators, 1-200 hp—20 pages

GEC-368F Panel Instruments, 2½, 3½, and 4½-in. sizes and accessories—12 pages

● **CRANES:** Bulletin PT-1253, 8 pages, covers push-type cranes, 500-8,000 lb, 8-30 ft spans. Industrial Crane & Hoist Corp, 315 N. Ada St, Chicago 7, Ill.

● **VALVE CONTROL:** A 4-page folder, SMA-000, covers LimiTorque Valve Controls for motorizing gate, plug, and butterfly valves. Philadelphia Gear Works, Erie Ave & G Street, Philadelphia 34, Pa.

● **WESTINGHOUSE BULLETINS:** Following are available from Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.:

B-6375 **Cotton Card Drives**—4 pages

83-520 Type FR **Microwave Radio** for voice, Teletype, telemetering, supervisory, and remote control; 1,700-2,000 Mc—8 pages

83-540 Type FM Multiplexing Equipment, for use with Type FR microwave radio, 300-600 kc, 30 channels—8 pages

84-200 Type FD **Power Line Carrier,** frequency-shift equipment for telegraphic or keyed-type functions; 120 v 50-60 cps, 129 v or 258 v dc—8 pages

84-400 Type FD Power Line Carrier, for voice—20 pages

84-500 Type FD Power Line Carrier, for directional-distance relaying or phase-comparison relaying—16 pages

● **CERAMIC COATINGS:** A 6-page folder covers ceramic coatings and porcelain enamels to combat corrosion, resist abrasion, withstand high temperatures. General Ceramics Corp, Keasbey, N. J.

● **HV TESTER:** Bulletin 14-1, 2 pages, covers Model 424 (0-5,000 v dc, 100 uA) and Model 421 (0-10,000 v dc, 500 uA) instruments for over-potential testing. Associated Research, Inc, 3758 W. Belmont Ave, Chicago, Ill.

● **ELECTROMETER:** A 4-page bulletin gives specifications on Model 210 electrometer having input of 10^{14} ohms and 6 uuf, and voltage ranges of 0-0.8, 2, 8, 20, and 80 v. Output amplifier will drive 0-1 ma recorder. Use of voltage dividers can extend range to 20,000 v dc and shunts will allow current measurements down to 5 x 10^{-14} amp. Keithley Instruments, 3868 Carnegie Ave, Cleveland 15, Ohio

● **ENGINES:** Bulletin J73, 16 pages, covers Type JS diesel, gas diesel, and gas engines, 13 in. bore, 16 in. stroke, 5-8 cylinders. Cooper-Bessemer Corp, Mount Vernon, Ohio.

● **WIRE ROPE:** Revised catalog, 50 pages, covers wire rope with recommendations. John A. Roebling's Sons Corp, 640 S. Broad St, Trenton, N. J.

● **CONDUIT:** Bulletin C-1, 8 pages, describes manufacture of rigid steel conduit. Rome Cable Corp, Rome, N. Y.

● **HF RESISTORS:** Bulletin F-1, 8 pages, covers high-frequency Type MP resistors, 1-6×10^8 ohms, 1-90 w. International Resistance Co, 401 N. Broad St, Philadelphia 8, Pa.

● **LAMPS:** A 4-page folder describes portable pin-up and standing lamps for the home. Moe Light, Fort Atkinson, Wis.

● **BEARING BRONZE:** Folder, 6 pages, gives specifications on continuous-cast bearing bronze, SAE 660, Asarcon 773. American Smelting and Refining Co, Barber Station, Perth Amboy, N. J.

● **RUBBER:** Catalog GC-4-54, 8 pages, covers engineering service and products of rubber and non-metallic materials. Neff-Perkins Co, 2130 St. Clair Ave, Cleveland 14, Ohio

● **RUPTURE DISCS:** An 8-page bulletin gives specifications and uses of precious-metal rupture discs for instant automatic release of excess pressure. Baker & Co, Inc, 113 Astor St, Newark 5, N. J.

● **STARTERS:** Booklet 1062, 16 pages, covers Type ZHS volt - ampere - limitor motor starters having self-contained air-core, current-limiting reactors, for 2,200-5,000 v squirrel-cage, wound-rotor, and synchronous motors. Electric Controller & Manufacturing Co, 2662 E. 79 St, Cleveland 4, Ohio

● **TEMPERATURE CONTROL:** Bulletin 103, 2 pages, gives specs on Models B-1C and B-1X temperature control or limit switch for temperatures under 300F. Burling Instrument Co. Inc., 16 River Rd, Chatham, N. J.

● **TIME SWITCH:** A 16-page bulletin describes "Skipper" time switches for automatic control of room air conditioners. Control can skip weekends or holidays. International Register Co, 2624 W. Washington Blvd, Chicago 12, Ill.

● **PACIFIC CATALOG:** Inserts bring Pacific catalog up to date (May 12).

Section 514 (1-54) Type BU units with batteries in separate compartment from rectifier—2 pages

Section 585 (3-54) Type RHE reclosing oil circuit breakers, 115-287.5 kv, conforming to new NEMA standards. Incorporates data on common-base breakers formerly in 586 (9-52). 8 pages

Section 712 (3-54) New information on aluminum clamp-type fittings and installation procedures for connecting aluminum conductors to copper or aluminum terminal pads. 4 pages

● **HV RESISTORS:** Bulletin G-1, 8 pages, gives data on 45 types of high-voltage resistors. Type MV, 2,500-20x10^8 ohm, 1-90 w, 3,500-100,000 peak v. International Resistance Co, 401 N. Broad St, Philadelphia 8, Pa.

TECHNICAL LITERATURE

FILM: CABLE, PATHWAY OF POWER—This 45 min film, sound and color, shows how electric wires and cable are made. Starting from 250-lb bars, film covers rolling, cleaning, drawing, stranding, mixing of rubber and plastic compounds for insulation, extrusion, braiding, and impregnation. Rome Cable Corp, branch offices, or Ridge St, Rome, N. Y.

FILM: THE ATOM GOES TO SEA—This 10 min black-and-white film is the first motion picture about atomic submarines. Presently being shown in commercial theatres, the 16mm version will be available in Sept. for general borrowing. Film gives a progress report on the Sea Wolf, USSN-575, giving an explanation of nuclear propulsion, the propulsion system, and the engineering problems encountered. General Electric Co, Apparatus District film libraries, or 1 River Rd, Schenectady 5, N. Y.

POLYETHYLENE PROTECTION—Technical Bulletin 100, 2 pages, gives abstracts of 9 articles on the incorporation of carbon black to increase life of exposed ethylene polymers from less than one year to more than 20 years. The black confines photo-oxidation to the surface. Acheson Dispersed Pigments Co, 2250 E. Ontario St, Philadelphia 34, Pa.

FLUOROTHENE RESINS—A 16-page booklet gives properties, forms, and fabrication information on fluorothene resins. These resins have high softening temperature, resistance to burning, chemical inertness, weathering and moisture resistance, and good low temperature properties. Recommendations on extrusion, injection, and compression molding are included. Bakelite Co, 20 E. 42 St, New York 17, N. Y.

Se RECTIFIERS—Bulletin 6.400, 24 pages, covers engineering information on selenium rectifiers. Information is included on cell sizes and ratings, circuits, formulae, characteristics, operation, coatings, applications, and terminology. Fansteel Metallurgical Corp, North Chicago, Ill.

Ge CRYSTALS—Industrial Uses for Germanium Crystals, 42 pages, gives ratings, characteristics, and typical applications. Price, 25¢. Sylvania Electric Products Inc, 1740 Broadway, New York 19, N. Y.

CENTRIFUGAL PUMPS—Form 7287, 12 pages, covers centrifugal pump fundamentals, defines terms, and gives typical calculations. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

MIXED-BED DEMINERALIZING—Automatic Mixed Bed Demineralizing at the Albany Steam Station, 8 pages, details experiences and economy of the first fully automatic mixed-bed equipment to produce make-up water. Bulletin 3983. Permutit Co, 330 W. 42 St, New York 36, N. Y.

TEMPERATURE CONVERSION—A 3½ x 8½ in. chart gives a temperature conversion table from —40F to + 568F (—40 to 298C). Moeller Instrument Co, 132nd St and 89th Ave, Richmond Hill 18, N. Y.

INSULATED WIRE—Book, 140 pages, covers insulation and jacket compounds; service, street-lighting, power, and control cables; power and lighting, and bare and weatherproof wires and cables; portable cords and cables; and insulated aluminum conductors. United States Rubber Co, 1230 Avenue of the Americas, New York 20, N. Y.

COATINGS—Reference Manual 545, 20 pages, covers adhesives, sealers, and surface coatings for use with heat insulation in industrial fields. Benjamin Foster Co, 4635 W. Girard Ave, Philadelphia 31, Pa.

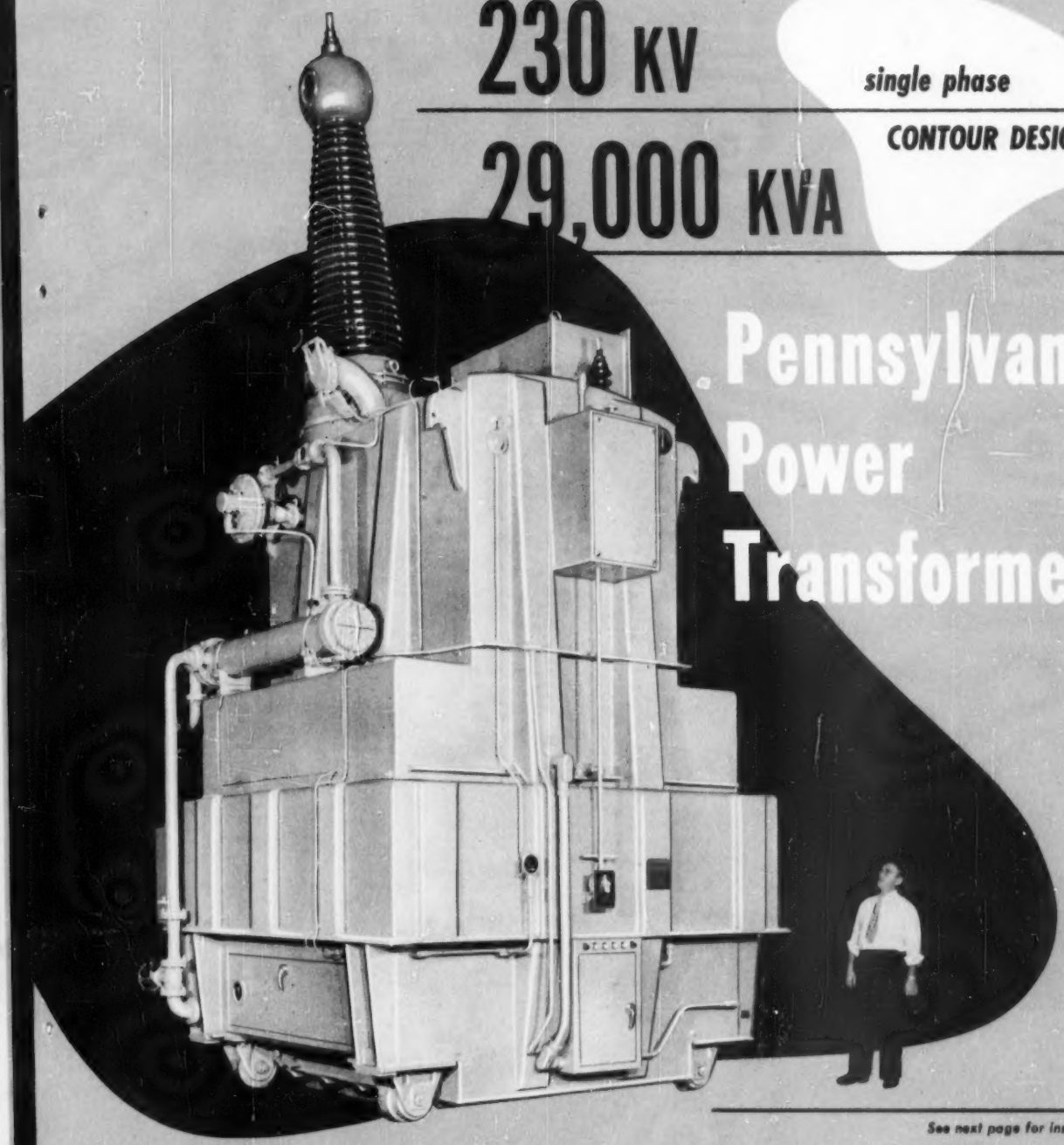
230 KV

single phase

CONTOUR DESIGN

29,000 KVA

Pennsylvania Power Transformer



See next page for inside story

Six of these shell form, Contour Design 230 Kv Pennsylvania Transformers were shipped to a power project on the West Coast to form two 87,000 Kva banks. The transformers traveled by train in an *upright position, completely assembled* except for bushings. Rated individually at 29,000 Kva, single phase, the transformers are designed to step up a generated voltage of 13,200 volts to a transmission voltage of 230,000 volts. Low operating temperatures are maintained in the transformers by means of forced-oil—forced-water heat exchangers.

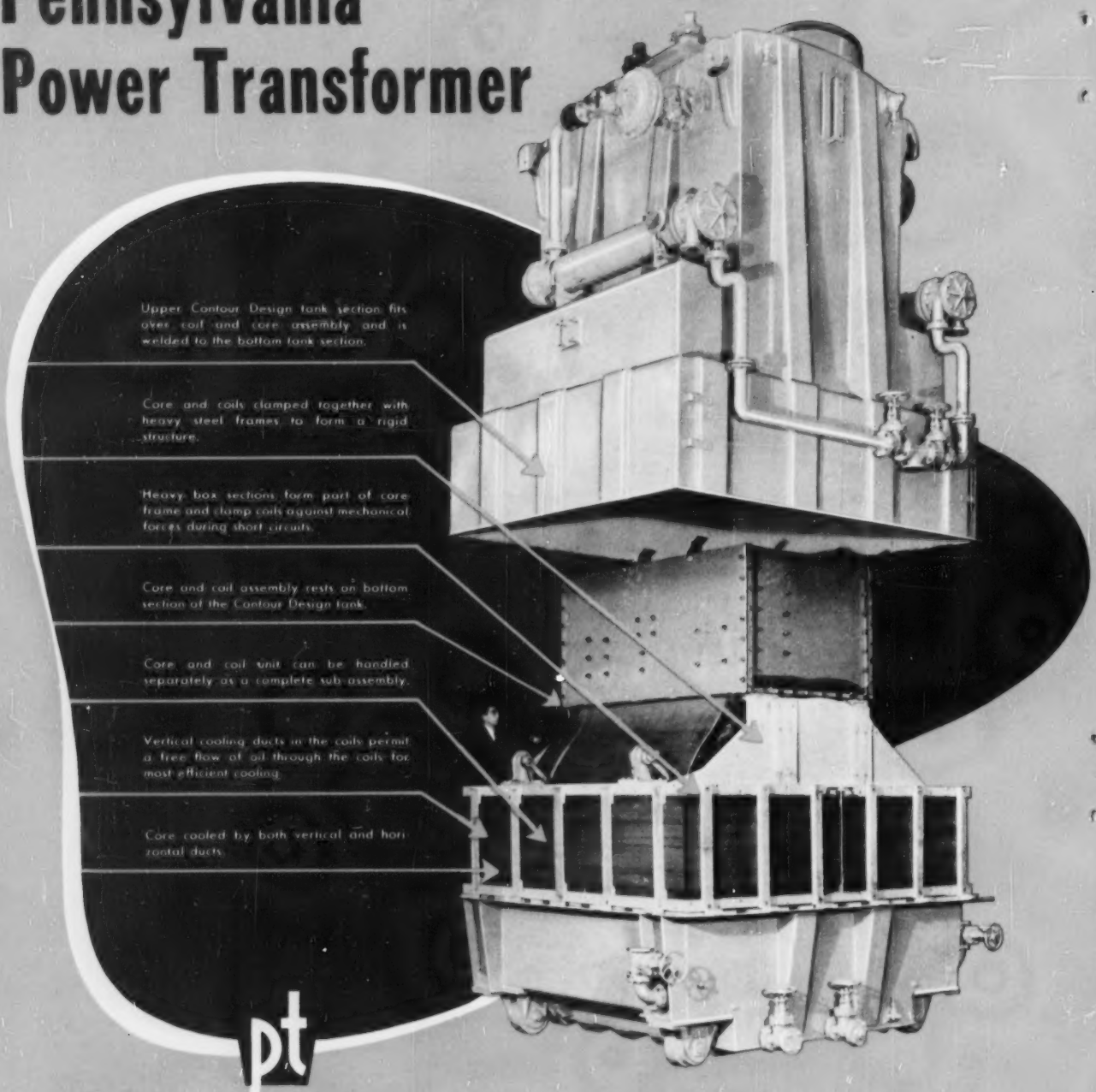
PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

Inside a 230 KV 29,000 KVA Pennsylvania Power Transformer

single phase
CONTOUR DESIGN


Upper Contour Design tank section fits over coil and core assembly and is welded to the bottom tank section.
Core and coils clamped together with heavy steel frames to form a rigid structure.
Heavy box sections form part of core frame and clamp coils against mechanical forces during short circuits.
Core and coil assembly rests on bottom section of the Contour Design tank.
Core and coil unit can be handled separately as a complete sub-assembly.
Vertical cooling ducts in the coils permit a free flow of oil through the coils for most efficient cooling.
Core cooled by both vertical and horizontal ducts.

pt

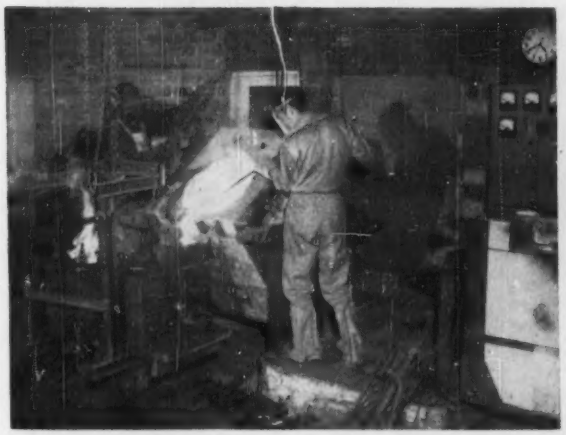
PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

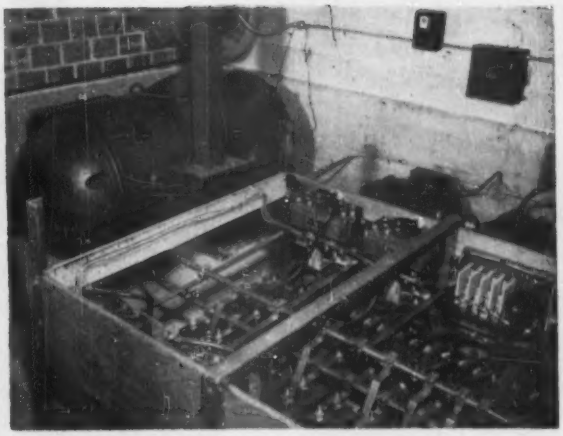
CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

For exterior view of this transformer, see other side.

INDUSTRIAL APPLICATIONS



STAINLESS STEEL and related alloy castings are melted in a 650-lb induction furnace fed from a 175-kw, 960-cycle, 800-v generator



POWER FACTOR CORRECTION is required as the furnace charge melts. It is supplied by 19 300-kva and one 147-kva capacitors

Induction Furnace Makes Precise Castings

R. M. PIZZA, Consultant Business Development Dept Utah Power & Light Co, Salt Lake City

Specialization in the production of high-quality stainless steel and related alloy castings is the aim of Induction Steel Foundry Co, Inc, Woods Cross, Utah. Operations are centered around a precise temperature-controlled induction-type furnace which melts steel or brass.

A 260-hp, 440-v, 3-phase motor drives a 175-kw, 960-cycle, 800-v, single-phase, 3600-rpm induction-type generator which powers the 650-lb capacity steel melting furnace. A control transformer rated 3 kva, 440/220 v, single phase, operates the controls and a capacitor contactor.

The capacitor bank consists of 19 15.3-mf, 300-kva units and one 7.5-mf, 147-kva unit, all rated at 2000 cycles maximum and 1250 v. This bank is looked upon as the only way to maintain the power factor as near unity as possible during melts. As the charge melts and passes from the magnetic to the para-magnetic state, the power factor rapidly becomes lagging if correction isn't provided.

Castings of mild steel and stainless steel, weighing from a few ounces to several hundred pounds, are produced. Plant capacity for an 8-hr shift is about 3500 lbs of castings.

Three 100-kva transformers, 12,000/480 v, supply power to the plant. Their average demand is 225 kw, which includes the demand of a 50-hp compressor, a sand-mixing machine, and heat-treating furnace large enough to handle an average day's run.

Electric Circulation Heaters Cut Engine Warm-Up

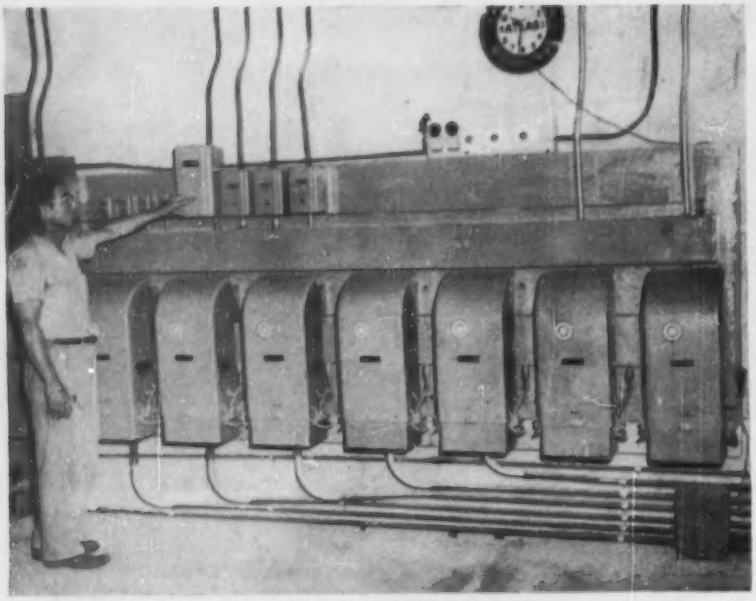
Diesel engines of three cranes and a switching engine at Buffalo Slag Co, Lackawanna, N. Y., are heated economically and efficiently with 2,000-w electric circulation heaters. Engines are kept ready to operate in coldest weather, safely and economically. Many man and equipment-hours which are ordinarily lost during warm-up are saved.

Heaters are attached to engine blocks with angle irons. With flexible connections to cooling system, regular types of antifreeze are circulated by natural convection through heater and engine block, warming engine in short time. Special pumps are not required.

Heaters have built-in elements, heating chambers, thermostats, and threaded inlets and outlets. On average winter mornings a 150 F setting is sufficient to heat most engines in a ½ hr. In colder weather heaters may be run all night at 90 F. Bx cable is run from heaters to outside lower rear of crane housing. Power is supplied from a station where crane is parked after use.

Edwin L. Wiegand Co

DIESEL ENGINE heater warms most engines to 150 F in ½ hr on average winter mornings. Built-in thermostat sets desired temperature



CONTROL PANEL for completely automatic plant which produces 400 bushels of fine corn meal daily. The six mills are each driven by a 30-hp motor. Electronic scales weigh corn

Electrified Plant Doubles Meal Production

WENDELL PEELE, Industrial Power Engineer, Virginia Electric & Power Co, Williamston, N. C.

Electricity has replaced water and diesel power at Abbitt's Mill, Williamston, North Carolina, with very satisfactory results. W. O. Abbitt, owner-operator of this modern corn meal plant, reports that not only is electric power proving to be less expensive than diesel, but that it is also much more efficient than hydro or diesel. During recent years, prior to a 1952 fire which destroyed the frame building plant, business growth made it necessary to rely much more upon diesel power than upon hydro because of a limited head of water. The new concrete block building plant has twice the capacity of the one destroyed by fire. It was placed in operation in 1953, and is completely electrified.

The completely automatic plant can produce 400 bushels of fine corn meal, daily, untouched by human hands. It is powered by motors aggregating nearly 300 hp. The six mills, made up of paired grinding stones cut from granite, are driven by individual 30-hp units, while another 30-hp unit is used at the sheller. Two 15-hp motors power the elevators, and a variety of smaller units drive the conveyers and various devices which clean and otherwise prepare the grain for grinding.

Electronic scales are used to weigh incoming grain corn at one end of the production line and packaged corn meal at the other. The receiving scales not only weigh incoming corn, but also corn to be sold from storage. For the latter purpose, the scales can handle more than 600 lb per minute in hundred pound lots. Powerful electromagnets are used on the production line to trap metal particles that might be accidentally mixed with the corn.

Power for the mill is supplied by the Virginia Electric & Power Company at 13.2 kv through a 225-kva transformer station delivering 480 v to the customer.

Heaters Cut Moisture

Drying electrodes with electric strip heaters at Littlefield Brothers, Inc, Cincinnati, O., has eliminated moisture in storage cabinets. It is essential that certain types of welding electrodes be kept dry. Three 200-w, strip heaters were mounted in the rear of each cabinet. A thermostat automatically maintains temperature above room temperature. L. J. Langevin, Cincinnati Gas & Electric Co.

INDUSTRIAL BRIEFS

Relighting entire accounting office and fourth floor of United Fruit Co, New Orleans, using six continuous rows of four 40-w fluorescent units provides nearly 100 ft-c of glarefree, well-distributed light. Company officials note a marked increase in employee efficiency and morale and they are well sold on the many advantages of modern office lighting. This installation is another step in company's program of relighting their entire building. Herbert Tardy, Commercial Representative, New Orleans Public Service Inc.

Drying hands with 10 kw in electric hand dryers in washroom at E. M. Green & Son, Inc, Nesquehoning, Pa., eliminates washroom bottleneck, saves employees time, does a better job of drying hands and improves employee relations. Company utilizes two 10-man wash fountains in employee's washroom and had only four towel cabinets, which created quite a problem at lunch and quitting time with 100 men trying to dry their hands. The result was not only loss of employee time, but a poor hand-drying job as well. Reason for only four towel cabinets was high cost of toweling. Clare Long, Industrial Power Representative, Pennsylvania Power & Light Co, Pottsville, Pa.

Cleaning dies used for rubber castings by electroplating with tin at Precision Rubber Products Corp, Dayton, Ohio removes minute particles of rubber, all extraneous deposits and does a thorough cleaning job. A very thin layer of tin is deposited on the dies. They are then put through a cold rinse tank and the tin is stripped off, like taking off foil. As the tin is peeled off it takes with it all the minute particles of rubber, and other deposits. If dies are to be stored, the tin is left on them for protection from rust and dirt. The tin is then removed when the dies are taken from storage. This process uses 18 kw of immersion heaters to speed the plating—three in the hot tank and three in the plating tank. A 15-hp motor drives the rectifier unit which has an output of 1,000 amp at 9 v. C. C. Day, Power Sales Engineer, The Dayton Power & Light Company.

A REEL-O-MATIC earns money for you by drastically reducing the costs of handling cable, wire rope, messenger strand, etc. In a matter of minutes, one man can measure, coil, and cut an order to specification . . . saving time, handling, and labor! REEL-O-MATIC does a *better* job faster.

In addition to the standard models shown, special REEL-O-MATICS are constantly being developed to suit specific needs . . . the REEL-O-MATIC principle has been successfully adapted to meet many unusual requirements of the U. S. Government, as well as private industry.

To ease your cable and wire handling problems, investigate REEL-O-MATIC . . . now!

REEL-O-MATIC CORPORATION of AMERICA
COLUMBIA 2, PENNA.

IN WITH THE NEW electric equipment as the Desert Oasis remodels its kitchen and dining room. Total electric cooking load totals 324 kw

OUT WITH THE OLD ranges installed in 1929 as they are moved to two other restaurants operated by the hotel in other parts of Spokane

New Ranges Take Over as 25-yr-old Units Move On

JOHN ADAMS, Commercial Representative, Washington Water Power Co, Spokane

Installation of new electric cooking equipment in the Desert Oasis hotel to replace the first all-electric kitchen in Spokane installed 25 years ago attests to the advantages of electric cooking. And to reduce the high cost of labor, the hotel has made use of automatic controls and labor-saving devices in its new installation.

Several innovations to expedite service and to facilitate the preparation and serving of food were added when the hotel kitchen and dining room were remodeled. New equipment includes electric hot-food cabinets for transporting food to banquet rooms and a conveyor belt for dishes. A tel-autograph system transmits

RAPID GROWTH in popularity of the bakery and take-home department is laid to the special lighting treatment. A tel-autograph system speeds orders to and from the main kitchen. It eliminates misunderstandings and errors

Note brush-free condition of sprayed right-of-way through timber-grown area, result of treatment with Dow brush killers.

DOW

DOW BRUSH KILLERS

CUT CLEARANCE COSTS

Esteron Brush Killer and Esteron 245 simplify maintenance of power and communication lines

Dow's low-volatility ester brush killers supply the answers to vegetation problems on right-of-ways, around installations and along roads. Esteron® Brush Killer or Esteron 245 enable your line cleaning crews to get their jobs done at savings from 25% to as high as 50% over hand cutting methods.

Esteron Brush Killer controls most woody plants including 2,4-D resistant species. Both products can be used as a water spray on foliage in growing season or in oil for year-around basal bark treatment. Both are effective for stump treatment in any season.

Where tough weeds and grass are a problem, write for the facts on late developments of Dow research. Our sales and technical men will be glad to help you plan your spraying program. THE DOW CHEMICAL COMPANY, Agricultural Chemical Sales Department, Midland, Michigan. In Canada: Dow Chemical of Canada, Limited, Toronto, Canada.

you can depend on DOW AGRICULTURAL CHEMICALS

DOW

REPLACE THEM WITH THE

NEW

SELF-CONTAINED

TIRFOR GRIPHOIST

CAPACITY 3300 LBS. (Single line)

TO 10 TONS WITH MULTIPLYING SHEAVES

Now—with the portable, manually operated, TIRFOR GRIPHOIST—you can do the work of winches, winch trucks, chain hoists and ratchet hoists. Thousands of these versatile machines have been ordered and re-ordered in the U. S. They're used by General Construction Contractors, Steel Erectors, Electrical Contractors, Truckers, Industrial Plants . . . Wherever lifting and pulling must be done better and easier at lower cost.

EXCLUSIVE FEATURES:

UNLIMITED CABLE TRAVEL—NO REEL, NO SPOOL.
Easily carried, set up and operated by one man.
Speed—10 ft. per minute either direction, load fully controllable at all times. Uses ½" wire rope.
Any Position—vertical, horizontal diagonal.
Safe—holds securely and automatically.
Weighs only 42 lbs.

UNIQUE IN ITS FIELD-WEIGHS ONLY 42 LBS.

Investigate the TIRFOR now.
Your dealer has it or can get it.
Write for descriptive Folder W today.

East of Mississippi—
Princeton Griphoist, Inc.
32 George St., Boston 19, Mass.

West of Mississippi—Griphoist, Inc.
700 Polk St., San Francisco 9, Cal.

Canada—J. A. Gosselin & Co., Ltd.
Drummondville, Quebec, Canada

orders to the kitchen, fountain, bar or take-home counter. This system sends the order by electrical impulses in the waitress' own handwriting. It eliminates misunderstandings and errors and provides fast, efficient service.

In addition to the three new ranges in the kitchen, there are four 6-kw griddles, four 4.5-kw fry kettles, a 12-kw electric pressure cooker and other smaller electric appliances. Including the bakery which has two 2-deck, 9-pan ovens with 50-kw load, the entire cooking operation of the Oasis amounts to 324-kw connected load. This load together with the hotel operation of about 125 kw results in a metered demand of 224 kw. Net end rate is 0.8¢ per kwhr.

To Combat LP Competition

A new 20-page booklet entitled "Electricity Versus Bottled Gas," designed to help utility salesmen, distributors and appliance dealers point out to consumers the advantages electricity has over LP gas, has been announced by the utility division of Hotpoint Co.

It incorporates the findings of independent research organizations and the extensive tests of the Housing and Household Equipment Division, Bureau of Human Nutrition and Home Economics, U. S. Department of Agriculture.

The booklet depicts factors of safety, cleanliness and speed of cooking with electricity vs. bottled gas.

Utility Lights Up for Jubilee

The Southern California Edison Co has lighted up the outside of its thirteen-story Los Angeles general office building in celebration of Light's Diamond Jubilee. One hundred thirty-nine floodlights, producing approximately 15,636,000 candlepower of brilliant white light, were turned on in May. It was the first full illumination of the building since the attack on Pearl Harbor. The Edison Co is sponsoring community observances of the anniversary in its southern and central California service area

To Capitalize on Diamond Jubilee Farm Story

Utmost local benefit from national publicity that will be given to a farm on its lines is the aim of the Pennsylvania Power & Light Co.

The September issue of "Farm Journal" will carry a "Diamond Jubilee" feature describing a farm where every practical use is made of electricity in the home and on the farmstead. Cooperating with Farm Journal and the farm owner to make this the most completely electrified farm in the nation were the power company, the National Electrical Manufacturers and the National Electrical Contractors Associations, plus many electrical, farm equipment, home furnishings, and building products manufacturers and suppliers.

Here is how Pennsylvania Power & Light Company intends to use the "Diamond Jubilee" feature to promote increased farm electrification in its service area:

1. A week before the feature is published a "news flash" postcard will inform PP&L's 34,000 farm customers of what is coming.

2. Each customer then will receive a copy of the feature.

3. Electric appliance and farm equipment dealers will be supplied with copies of the story and with window banners tying in with the promotion. They will be urged to make special floor and window displays and special mailings of promotional literature.

4. PP&L advertising in local newspapers will play up the "Diamond Jubilee" farm in September.

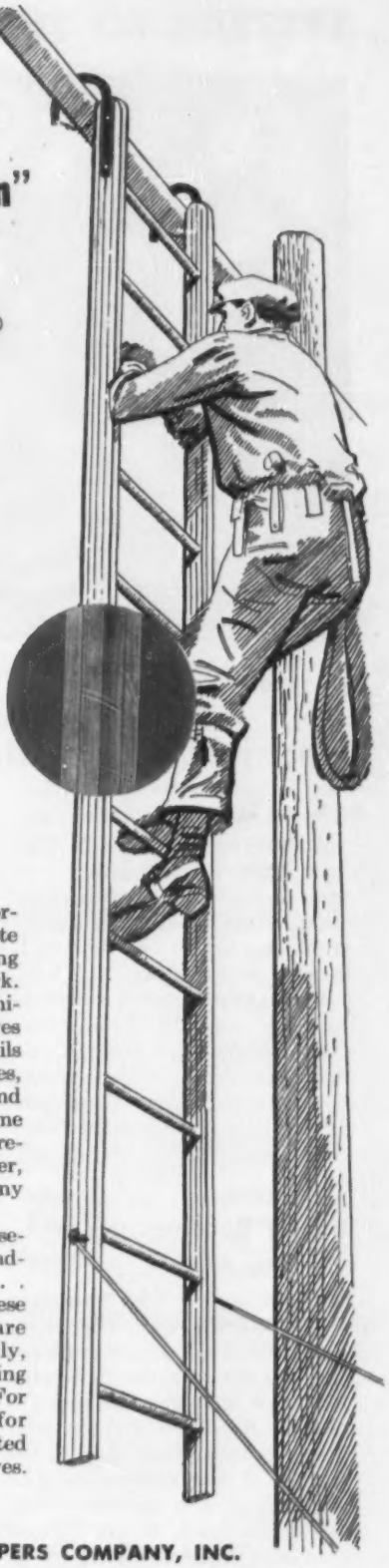
5. Farm programs of radio stations will include specially prepared "Diamond Jubilee" scripts.

6. Special programs will be made available to rural civic organizations, granges, 4-H Clubs, FFA groups, church clubs, etc. These programs will include the "Diamond Jubilee" movie plus a short talk emphasizing the local significance of the celebration.

Quoting R. T. Jones, Pennsylvania Power and Light Company's farm sales manager:

"It is our hope that Farm Journal's September feature will give to farmers all over America a greater appreciation of what electricity offers them in higher profits, in labor saving, and in better living."

New laminated "composite construction" with PENACOLITE® ADHESIVES makes this ladder stronger, safer, longer-lived



BODENDIECK Tool Co., of Taylorville, Illinois, uses a "composite construction" technique in making their new hook ladder for line work. The side rails and rungs are laminated with "Penacolite" Adhesives . . . the thick inner plies of the rails are Sitka Spruce and the outer plies, which take most of the stress and wear, are pecan hickory or some similarly strong, hard wood. The result is a ladder that is much stronger, safer and longer-lasting than any solid stock ladder would be.

"Penacolite" Adhesives were selected because of the truly dependable strength of their bonds . . . strong as the wood itself. And these Koppers Resorcinol Adhesives are easy to work with and set quickly, forming bonds that are long-lasting . . . will not weaken with age. For additional information, write for your free copy of Koppers illustrated booklet on "Penacolite" adhesives.

KOPPERS®

KOPPERS COMPANY, INC.

Chemical Division, Dept. EW-6284, Koppers Bldg., Pittsburgh 19, Pennsylvania

PENACOLITE® RESORCINOL ADHESIVES

The original waterproof, room-temperature-setting adhesives

LETTERS TO THE EDITOR

This metering jumble was . . .

changed to this neat arrangement possibly because

Electrical World Editorial Influenced Apartment Owner

To the Editor:

An editorial in the Sept. 7, 1953, issue, entitled "Inadequate Wiring—A Sore Spot Gets Sorer," related to inadequate wiring in apartment buildings concerned with proposed installation of air conditioning units. This was of particular interest to me because I had just completed a design of wiring changes for a local apartment house, and I believe your editorial contributed to the customer's decision to proceed with this work.

The job was performed by C. O. Darney, a local electrical contractor, on a time-and-material basis at a cost of approximately $35,000. These premises consist of a number of six-story buildings, and each apartment was individually metered with electric meters located in the basement. From the meters a ½-in. conduit with two No. 12 wires ran to a fuse box in each apartment. This antiquated system was replaced by installing a circuit breaker at each meter location, running a ¾-in. conduit containing three No. 8 wires to each apartment, and installing a circuit breaker distribution panel for each apartment. The enclosed pictures are of one of these meter locations before the rewiring job was done.

R. W. Meade
Industrial Power Dept
Consolidated Gas Electric Light & Power Co
Baltimore, Md.

A First Becomes a Third

To the Editor:

In your issue of June 7 an article on the Southwestern Public Service Co refers to its economic loading of generators and states that its adoption of the new method in the spring of 1953 was the first in the Southwest. If the Mississippi River is the eastern boundary of the Southwest, the statement given above is not quite correct. The Middle South System operator began using economic loading for the Arkansas Power & Light Co, Louisiana Power & Light Co, and Mississippi Power & Light Co in the fall of 1951. This was the second economic loading study made by Ebasco Services after the pioneer study of the Florida Power & Light Co system, made at Purdue University in 1949.

In another paragraph of the above article reference is made to 186 kvar of capacitors installed on the system. Presumably this should be 186 Mvar.

These two minor corrections "to keep the record straight" are not intended to detract from an interesting article about an excellent company which is making a fine record in developing its area. The SWPS Company has worked out many improvements in various fields, including economic loading. The conference on economic loading in Amarillo in September, 1953, covered the subject in an excellent manner and stimulated interest throughout the Southwest.

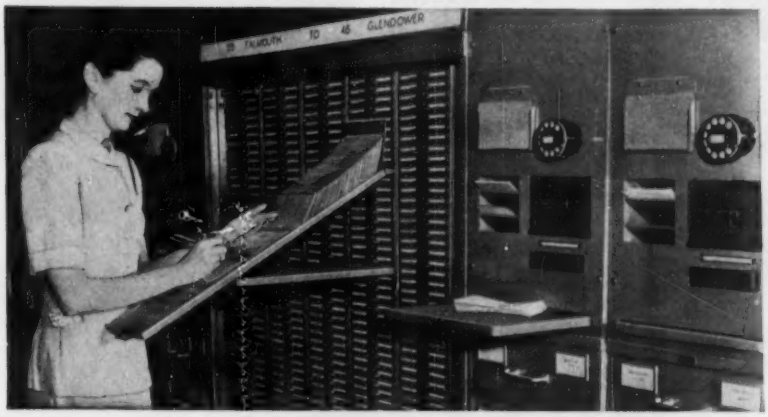
E. E. George
Electrical Engineer
Ebasco Services, Inc.
P. O. Box 2899
Little Rock, Ark.

• Electrical World acknowledges that reader George is perhaps as much responsible as any one person for pioneering the method of economical loading mentioned in the June 7 issue. This method was fully described in a technical article by three authors which appeared on page 60 of the May 31 issue.

Remington Rand

BETTER BUSINESS METHODS

For Greater Profits Through Lower Costs



Could You Handle a 300% Surge in Service Calls in One Day, with no Stress or Strain?

This Customer Service System, at work in a New England public utility, boosts public relations daily and cuts costs. All service records on a given group of street addresses "belong" to one clerk, who handles any call for service or information within her group promptly and accurately, *before* the customer leaves the phone. This eliminates duplicate and inaccurate orders, speeds service and cuts truck time of men performing the work.

In the pocket corresponding to each street location are a master card, a traveling meter order, and a traveling service investigation form which serves to originate actual field maintenance. For more details on this Customer Service System and its huge potential, see Booklet X1498.

Unit Bookkeeping Plan Ends Specialized Customer Accounting, Adds "Point-of-Use" Record Protection

Under the Unit Plan, all "bill information" inquiries are answered quickly from this one source . . . the Unit Plan Safe-Desk. Records stay at a desk permanently, and each clerk becomes familiar with "her" 8,000 to 9,000 accounts, boosting accuracy, production and morale.

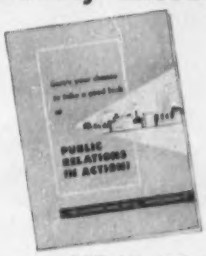
The Unit Plan provides for fair comparison of quantity and quality of work performed by each clerk. And, insulated Safe-Desks protect records from fire at "Point-of-Use" 24 hours a day. For more facts on Unit Plan Bookkeeping in the public utility field, read Booklet X1498.

Customer Service Counter Modern and Functional; Solves Customer Cashiering and Bookkeeping Problems

The new sectional customer service counter may be used alone, or with other units, to provide any desired number of work stations. The counter is open and friendly in appearance, promoting pleasant customer relations. It offers ideal counter height for making out checks and applications, plus a convenient, continuous parcel shelf.

The counter's compact working side holds all cashiering and bookkeeping facilities within arm's reach. Fatiguing, "stand-up" counter cashiering is eliminated. Certified insulated units protect valuable records at "Point-of-Use" 24 hours a day. Read more about this efficient public relations tool for public utilities in Booklet X1498.

12 Fact-Filled Pages For Public Utility Executives



Your free copy of "Public Relations In Action", Booklet X1498, is waiting for you. The coupon below is for your convenience. Mail it today!

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NEWS ABOUT PEOPLE

McKibben Is Appointed A VP

Green Mountain Power names former Stone & Webster official to executive position. Clewley is named chief engineer

GLEN M. McKIBBEN

Green Mountain Power Corp has announced the election of Glen M. McKibben as a vice president and the appointment of G. William Clewley as chief engineer. Before assuming executive posts with the Burlington, Vt., utility, McKibben was associated with Stone & Webster Service Corp and Clewley was with the Vermont Public Service Commission.

McKibben will make his headquarters at Burlington, and Clewley will be headquartered at Montpelier, Vt.

G. WILLIAM CLEWLEY

Engineering Background . . . Vice President McKibben was graduated from Oregon State College in 1935 with an electrical engineering degree. Until 1940 he was in the engineering department of the West Coast Power Co, Portland. Since then, except for three years as general manager of the Walden (N. Y.) Telephone Co, he has served in various engineering and executive posts in the New York and Boston offices of Stone & Webster Service.

Clewley entered the utility field in 1928 as an employee of the Newport (Vt.) Electric Co, later becoming its manager. In 1941 he joined the staff of the Vermont PSC. For the past several years he has been chief engineer of that board with offices at Montpelier.

•

William M. Wallace, since 1951 assistant to the vice president of Allis-Chalmers Manufacturing Co's General Machinery Division, has been named assistant manager of the division's power department.

Samuel Untermyer II, designer of a number of nuclear reactors and a former chief project engineer at Argonne National Laboratory, Lemont, Ill., has joined the Atomic Power Study staff of the Atomic Products Division of General Electric Co. Before going to Argonne in 1948, Untermyer was associated for two years with the engineering staff at the Oak Ridge (Tenn.) National Laboratory.

Charles J. Dunne, previously special staff assistant in the treasury department of Long Island (N. Y.) Lighting Co, has been named an assistant treasurer.

Jon R. Ruhlman, assistant technical director of Preformed Line Products Co, Cleveland, since 1952, has been appointed technical director of engineering and research activities to replace **Jess C. Little.**

E. L. ROBINSON

Robinson Elevated

Gulf States Utilities promotes veteran employee to general sales managership

E. L. Robinson, manager of the Beaumont Division of Gulf States Utilities Co, Beaumont, Tex., has been appointed general sales manager of the company.

His promotion was one of eight involving top jobs in the utility system's five divisions.

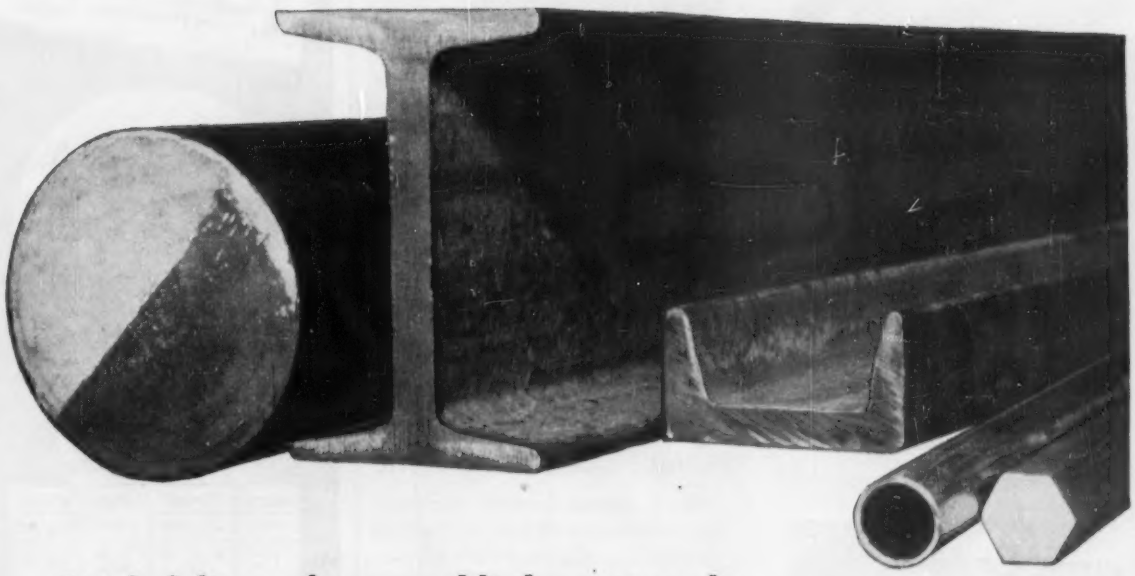
Robinson's division post will be filled by E. L. Granau, formerly manager of the Navasota Division. C. M. Scott, formerly operating superintendent of the Beaumont Division, was made manager of the Port Arthur Division to succeed J. B. Hodge, who replaces Granau at Navasota.

New Superintendent . . . J. B. Coltharp, superintendent of electrical transmission and distribution, Baton Rouge Division, was advanced to succeed Scott as Beaumont Division operating superintendent.

Formerly operating superintendent of the Lake Charles Division, L. M. Welch was promoted to fill the vacancy at Baton Rouge. F. W. Merrill, formerly Port Arthur Division operating superintendent, moves to Lake Charles to replace Welch.

F. R. Smith, formerly Port Arthur Division operating supervisor, was promoted to replace Merrill as operating superintendent of the Texas

call Ryerson for steel carbon, alloy, stainless



Quick delivery from world's largest stocks

Whether you need a single piece or a truckload you can depend on prompt, personal service from your nearby Ryerson plant. So, for every kind of steel—when you need it—call Ryerson.

RYERSON CERTIFIED STEELS

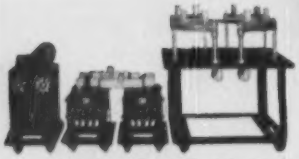
RYERSON STEEL

Principal products in stock: bars, structurals, plates, sheets, tubing, alloy & stainless steel, reinforcing, etc., also machinery & tools

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE, N. C. • CINCINNATI • CLEVELAND DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

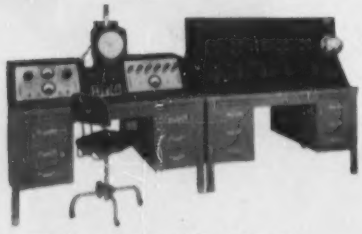
TESTING . . .

Some Testing Departments are still using inherited equipment left over from another day. They continue to "go along" with it, perhaps not fully realizing the availability of newer, more versatile, more adaptable equipment. Why not let States Co., leaders in this field, show you how their latest testing equipment can better serve your testing needs.



• CURRENT TRANSFORMERS

Form "CTT" (Portable Type) Testing Outfit—Range from 1200 to 10,000 ampere capacities. This portable type outfit provides source of heavy current for testing current transformers at point of installation and with smooth adjustment through range of outfit. Stationary types also available.



• THERMAL DEMAND METERS

Form FDM Control Table and Rack Table—one of the numerous styles of States Thermal Demand tables.

Provides control of the load of from 1 to any desired number of thermal meters under test. Wide variety of styles of tables.

THE STATES COMPANY
19 New Park Avenue, Hartford, Conn.
I am interested. Please send further information on
☐ Current Transformers ☐ Thermal Demand Meters

Name ..... Title .....
Firm .....
Address .....
City ..... Zone .... State .....

utility's Port Arthur Division.

Did Meter Work . . . The new general sales manager joined Gulf States in 1921 shortly after graduating from Agricultural & Mechanical College of Texas, where he received a degree in electrical engineering. After working in the meter and railway departments at Beaumont, he went to Port Arthur where he served from 1925 to 1926 as a meter foreman.

Robinson then went into power sales at Beaumont, later serving as superintendent of sales for the Navasota and Lake Charles Divisions. In 1943 he returned to Beaumont as manager of industrial sales, advancing in 1947 to the division managership.

DAN. E. DUNNE

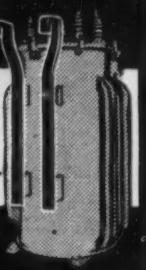
Heads Penn-Union Electric

Dan E. Dunne, formerly vice president and director of sales of Lighting Products, Inc, Highland Park, Ill., has been appointed president of Penn-Union Electric Corp, Erie, Pa. He succeeds the corporation's founder, Charles L. Stoeltzlen, who will remain in a consultant and advisory capacity. After serving as an ordnance officer with the Navy during World War II, Dunne became associated with Lighting Products, first as sales manager and later as vice president.

•

Robert H. Morse III, for the last two years general manager of the Beloit (Wis.) plant of Fairbanks, Morse & Co, has been appointed assistant to the vice president in charge of sales with headquarters in Chicago. In another appointment, **W. E. Watson**

THIEL
TRANSFORMER HANGERS



MODEL	C-1	C-3
TRANSFORMER	75-100 KVA Single-Phase	75-112½ KVA Three-Phase
WEIGHT	46 lbs.	100 lbs.

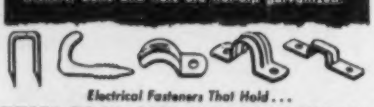
Thiel Hangers, made according to NEMA specifications, are hot-dip galvanized to insure dependable service. In two styles, complete with galvanized bolts and nuts.

MODEL	1-PHASE	3-PHASE	WEIGHT
T-1	3-15 KVA	9 KVA	16¼ lbs.
T-2	25—37—50 KVA	15-45 KVA	37¼ lbs.

Hangers and Kickers in Stock!

HANGER KICKERS

MODEL K-1, which can be mounted in four different positions, is designed for use with T-1 Hanger shown above. MODEL K-2, for use with T-2 Hanger, has five mounting positions. Kickers, bolts and nuts are hot-dip galvanized.



Electrical Fasteners That Hold . . .
THIEL TOOL AND ENGINEERING CO.
1417 No. Market St. • St. Louis 6, Mo.

was made manager of the Beloit Works. For the past year and a half, Watson has been works manager of the company's affiliate, Canadian Locomotive Co, Ltd, Kingston, Ont. Both appointments become effective July 1.

Salt River Power District Hires 3 USBR Engineers

Salt River Power District at Phoenix, Ariz., has hired three engineers who formerly served with the Bureau of Reclamation.

S. A. Ward, Power District general manager, announced appointment of Leslie M. Alexander to the newly created position of development and sales manager, and E. K. Carpenter, supervisor of engineering and economical analysis, and F. R. Lupton, supervisor of marketing and sales, to serve under him.

Prior to joining the Power District, Alexander was power manager for Region 3, Bureau of Reclamation at Boulder City, Nev. He had charge of power deliveries from Hoover, Davis, and Parker Dams.

Carpenter, for the past seven years, was an electrical engineer for the bureau in Region 3, and Lupton served as chief of the power scheduling and billing branch for the Parker-Davis Project for four years.

•

J. P. Elmore has been appointed project manager of the Reclamation Bureau's Klamath Project in southern Oregon and northern California to succeed **E. L. Stephens,** who has retired after 43 years of service with the bureau. With Reclamation since 1946, Elmore for the last two years has been assistant project manager directing the Operations Division of the Klamath Project. Earlier he had been assistant power manager supervising marketing programs in the bureau's regional headquarters in Sacramento, Calif.

Oscar R. Eichenberger has been named director of sales of Consumers Power Co. In his new post he will coordinate sales activities of the company in both the electric and gas departments. He has transferred to his new duties in the utility's general offices in Jackson, Mich., from the Grand Rapids Division, where he has

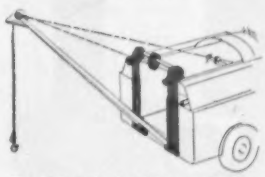
Fold Up Your Derrick from Inside The Cab!

U. S. Patent No. 2,336,965

with the Tel-E-Lect STORAGE KIT

Derrick raised by simply engaging the winch.

Vertical position—winch rotation reversed.



Derrick is locked in operating position.

★ Saves Space
★ Saves Time
★ Saves Money

You know what a tough job it is to assemble an "A" frame derrick—and to put it away after use. Now Tel-E-Lect has a simple solution with a real dollar saving in time on the job—a saving of space on your trucks—and a saving in many hours of back-breaking and hazardous work for your men.

The patented Storage Kit fits any standard utility truck body and "A" frame derrick and it can be quickly bolted on the back of your truck by your local mechanic. The derrick will go up or down in a minute or less, entirely controlled by the man in the truck cab. Working with a double drum winch, you get live boom operation—or easily adjustable derrick elevation with a single drum winch.

The cost is only a fraction of other, more intricate derrick storing systems—and there's no rebuilding of your present equipment!

So, while you're thinking about it, drop a line to Tel-E-Lect for diagram and price. It's sensational!

Earth Boring Equipment for All Types of Trucks

Tel-E-Lect
PRODUCTS, INC.

10,001 Minnetonka Blvd.
Minneapolis 16, Minn.

PULL *and* POWER

Tulsa Winch models for all trucks from ½-ton up.

Tulsa Winches for all crawler tractors complete with transmission, line roller assembly and mounting brackets ready for installation.

Jobs are handled with ease, speed and positive safety with a Tulsa* Winch. To get the most work from your truck or tractor, install a Tulsa Winch. Available in 28 different models in capacities from 6,000 to 80,000 pounds, there is a Tulsa Winch to meet every winching requirement.

PUBLIC UTILITY

Extended drum shaft with easily removable nigger-head. 6,000 to 25,000 lbs. Capacities

*Reg. U. S. Pat. Off.

Tulsa* Winch

TULSA, OKLAHOMA DIVISION OF VICKERS Inc.

served as new business superintendent since 1951. At Grand Rapids, he will be succeeded by **Randall W. Woodcock,** a power engineer in the Saginaw Division.

Kenneth Kasschau, currently director of the Research and Medicine Division of the Atomic Energy Commission's Oak Ridge, Tenn., operation, has been named manager of engineering of the newly established atomic energy projects department of American Locomotive Co, Schenectady.

Ned E. Desenberg has joined Malleable Iron Fittings Co, Branford, Conn., as a sales engineer. He previously was associated in an engineering capacity with Public Service Co of Indiana and Ohio Edison Co.

John A. Wright has been elected president of Curtis Lighting, Inc, Chicago, to succeed **Darwin Curtis,** who remains a member of the board of directors. Wright has been associated with Curtis Lighting for several years as its attorney.

Cyrus Erickson, head of tthe legal dapartment of Northern States Power Co, has been appointed to the newly created position of general counsel. Erickson, a graduate of Carlton College and Harvard Law School, joined Northern States Power's law department in 1926.

Guy L. Morrill has been elected vice president of Midwest Piping Co, Inc., St. Louis. Morrill will continue to make his headquarters in Los Angeles, where he has been manager of the firm's West Coast plant since it was established in 1927. He joined Midwest in 1921.

J. B. Owens has been named an assistant chief engineer of the R&IE Equipment Division of I-T-E Circuit Breaker Co, Greensburg, Pa. Owens, an electrical engineer, will head up the engineering activities on power switching equipment. In 1949 he was made supervisor of power switching equipment engineering.

R. G. Medlock, field superintendent of Grand River Dam Authority, has been named assistant general manager of GRDA. Medlock, who has filled the superintendent's post since 1948 from headquarters at Pryor, Okla., will be succeeded by **John B. Godwin,** super-

TO BOOST CAPACITY 30 -50%

JUST CHANGE CABLES TO

ROCKBESTOS AVC®

(N.E.C. TYPE AVA)

You get long life, dependable service under severe operating conditions because these walls of impregnated felted asbestos permanently resist heat and moisture, mechanical damage and effectively seal the high dielectric varnished cambric tapes from deterioration.

Here's a fast, economical way to increase your existing current capacity. Just re-wire with Rockbestos A.V.C. Size for size, A.V.C. carries 30 to 50% more current than ordinary insulated cable.

Saves you buying and installing new conduit, new fittings. Lowers your labor costs. Takes less downtime to make the change-over.

And because it's a better insulated cable, Rockbestos A.V.C. gives you more years of dependable service, too. For the complete story, write for booklet "Cut Current Carrying Costs."

STOCKED COAST TO COAST

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intendent of the Pensacola power plant. **H. P. Doering,** assistant superintendent of the steam plant at Pryor, has been advanced to superintendent. **Keeling McCoy** has been named superintendent of the Pensacola power plant to replace Godwin.

Charles M. Coleman, a member of Pacific Gas & Electric Co's advertising and publicity staffs for the past 21 years, has resigned. Before becoming a special writer and historian for the utility, Coleman served Hearst newspapers for 23 years.

Executive Appointments Are Announced by RCA

Several executive promotions have been announced by Radio Corp of America. Dr Elmer W. Engstrom, executive vice president of RCA Laboratories, was elected executive vice president of research and engineering. Dr Engstrom, who continues as head of the laboratories, will make his headquarters in New York. Ewen C. Anderson, vice president of the commercial department, was appointed executive vice president of that department with headquarters in New York.

Dr Irving Wolff, director of research, was made vice president of research for the laboratories at Princeton, N. J. Dr D. H. Ewing, director of the Physical and Chemical Research Laboratory, was named administrative director of the laboratories at Princeton. O. B. Hanson, vice president and chief engineer of the National Broadcasting Co, was elected to the RCA staff as vice president of operations engineering.

•

C. E. Hockings, assistant to the president of Tucson Gas, Electric Light & Power Co, has been elected a director of the utility.

Ira Horner has been made manager of power transformer sales for Pennsylvania Transformer Co. In other appointments, **W. G. Swoish** was named manager of distribution transformer sales, and **E. P. Zimsky** was appointed sales engineer for Rural Electrification Administration accounts. All three will make their headquarters at the company's general offices in Cannonsburg, Pa. Be-

fore joining Pennsylvania's sales engineering staff, Horne was associated with Peter F. Loftus Corp, engineering firm. Swoish has been serving as sales engineer in firm's Pittsburgh district sales office and Zimsky in the company's order department.

OBITUARY

Nathaniel R. Richardson, 56, vice president and works manager of Electric Controller & Manufacturing Co, Cleveland, died there June 14. A graduate of the Sheffield Scientific School of Yale University, he joined EC&M in 1924.

Leroy L. Newman, electrical research consultant for New Orleans Public Service, Inc., died June 3. He had been with the Louisiana utility since 1923, serving for many years as superintendent of the Electric Distribution Division.

Arthur G. Lang, an engineer with the Hydro-Electric Power Commission of Ontario for 32 years, died recently. He was in charge of designs and construction of all lines and distribution systems under 10,000 v.

Alexander Dovjikov, 67, research engineer for Bonneville Power Administration since 1940, died in Portland, Ore., June 3. Dovjikov, a native of Rostov, Russia, planned to retire July 1 because of his health. At the time of his death, he was engineer of applied research for projects at Bonneville involving high voltage power systems.

W. M. Cartwright, 77, retired chief engineer of the Denton (Tex.) Water & Light Department plant, died there June 10.

Frederick W. Eaton, 61, who served for about 30 years as engineer in charge of operations for Central Maine Power Co, died recently at Augusta, Maine. In 1952 he was made manager of the utility's station and transmission department.

Ralph E. Curtis, 87, formerly affiliated for over 20 years with Boston Edison Co's engineering and purchasing departments, died June 2 at Danvers, Mass.

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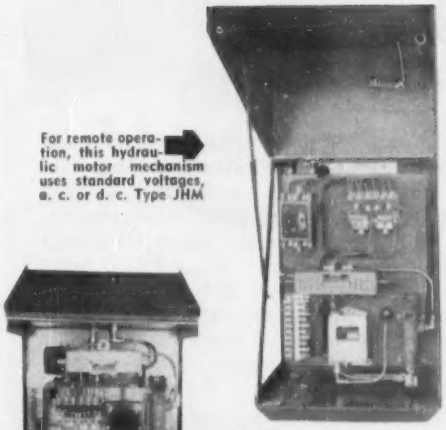
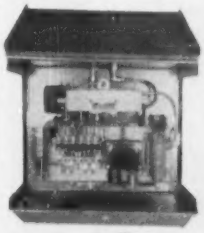
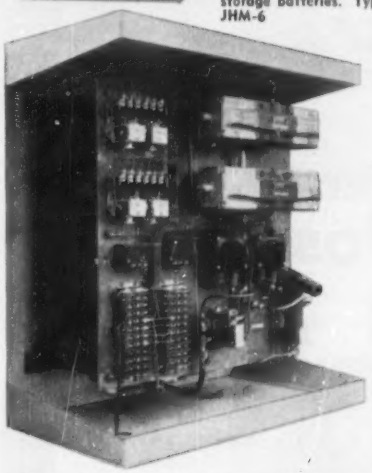


For remote operation, this hydraulic motor mechanism uses standard voltages, a. c. or d. c. Type JHM



For remote operation, this mechanism incorporates 6-volt storage batteries. Type JHM-6



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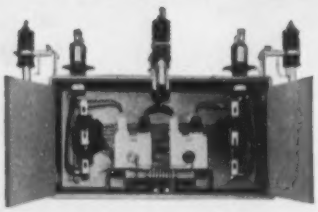

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Adequate Rates

(*Continued from page* 116)

of public utility companies, and is not clothed with the general power of management incident to ownership.'"

He summed up his speech by saying: "Looking down the road, there is a big job to be done. Future rate policies for adequate public service must consider that: (1) Peak load requirements will more than double within ten years; (2) management, materials and money will be needed in ever increasing amounts; (3) maximum responsibility will be placed upon management to provide the utility service so necessary to our way of life; (4) employees will have to be better educated and organized for the job to be done; (5) customers will have to be better informed as to the value of the service; and (6) regulators will have to review and revise those regulatory standards and interpretations that will be detrimental to a broader concept of adequate public service.

There is a challenge to be met in your future pricing plans. By boldly meeting this challenge you will bring to the public the **best** service at a **reasonable** price," he declared.

PUC Allows Ohio Edison to Hike Industrial Rates

Ohio Edison Co has been granted authority by Ohio Public Utilities Commission to increase rates to industrial customers by $1,902,022 a year.

The utility, which operates in 35 counties and 64 communities, will replace its present 23 industrial rate schedules with two new ones. Ohio Edison last June was granted permission to increase rates to rural and rural commercial customers and was granted rate increases by 29 local ordinances.

Permission was also granted to Ohio Edison to consolidate 19 "fuel adjustment clauses" (providing for automatic rate increase to industrial users when the cost of coal rises) into one. Some present contracts do not contain the clause.

The commission authorized Ohio Edison to amend its tax adjustment contract clause to provide that bills would be adjusted to offset the imposition or removal of any new or in-

creased tax levied upon the company's generation, distribution, or sale of electricity after Jan. 1, 1954.

Approval of Tacoma's Rate Schedule Stymied

Final action on a new City Light rate schedule at Tacoma, Wash., has been postponed until June 28, as the result of protests by appliance dealers and home-owners using space heaters.

Protests centered on one section which would raise light rates to 15 mills for those consumers using more than one and a half times their monthly average kilowatthours consumed in the four months preceding Oct. 15 of each year or more than 1,500 kwhr per month. This section was blasted as "discriminatory, unfair and designed to penalize Tacoma City Light's best customers."

Spokesmen for appliance dealers suggested that the 4% of City Light customers who would be paying high winter bills under this section should have the option of continuing under the present schedule, under which their lowest bill is 65% of the average of the four highest months.

Springfield, Ore., Council Authorizes Power Study

Springfield, Ore., city council has authorized Mayor E C Harms to name a committee to study whether the municipal system now competing directly with service offered by Pacific Power & Light Co, formerly Mountain States Power Co, should buy the private system or sell its system.

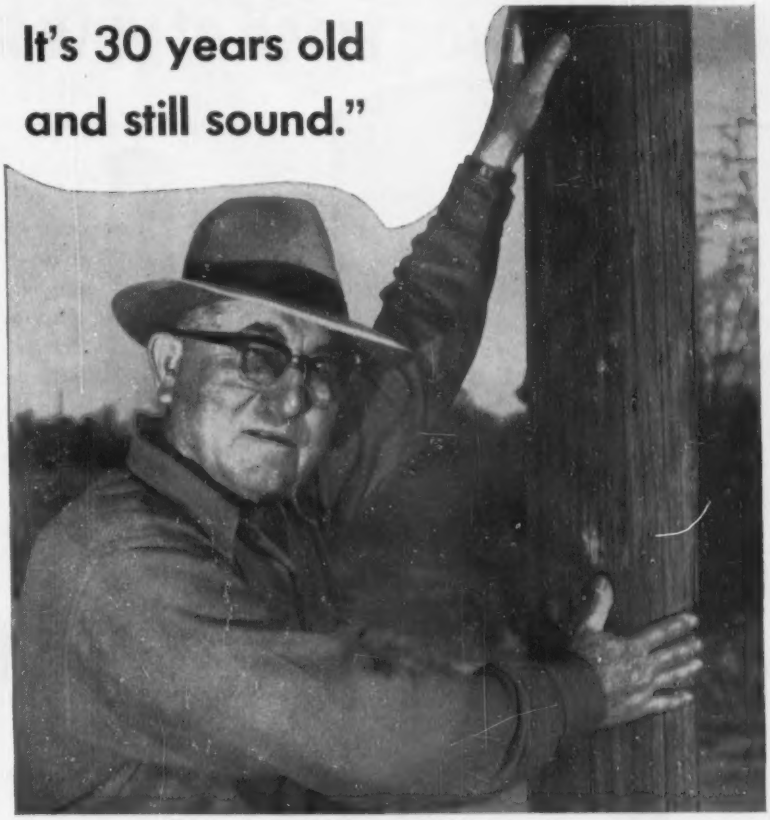
The Springfield utility board has filed a report with the city council saying duplicate power facilities are not in the public interest.

Councilman Arthur McChesney said, in commenting on this report, that "There is a recommendation due. We must decide whether we should sell out or whether we should buy out."

The Mayor has noted that the three-year-old city system claims to serve more than half the homes in Springfield but the private company has over 80% of the business service load. He has indicated that condemnation proceedings might be started against Pacific's holdings.

Line Foreman Praises Koppers Poles:

"Here's what I call a good pole. It's 30 years old and still sound."



W. E. DeVanie, Line Foreman, Maintenance and Construction, Southwestern Gas and Electric Co., Texarkana, Texas. This Koppers Pole is part of a transmission line erected in 1924.

● W. E. DeVanie, shown here, knows all about poles. For 36 years he has been doing maintenance and construction work for the Southwestern Gas and Electric Co., Texarkana, Texas. In 1924, when he was made Line Foreman, one of his first assignments was to supervise the construction of a 7-mile transmission line.

Here's what Mr. DeVanie says about this line: "Only Koppers Pressure-Creosoted Poles were used. During the 30 years since this line was built, some poles have been hit by lightning. Others have been removed so that longer poles could be installed at road crossings. I can't remember having to remove a single pole because of decay."

This shows the kind of service utility companies are getting from Koppers Pressure-Creosoted Poles. By lasting so long, these poles cut maintenance and replacement costs. They make line operation more efficient as well as more economical. Write for prices and further information on Koppers Poles.

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Now you can boost power factor on heavily loaded secondaries *at lower cost per kilovar than ever before.*

The new Westinghouse 3 and 5-kvar secondary capacitors offer you an exclusive cost-reducing design feature: tubular cases of 16-gauge extruded aluminum. They weigh only 16 and 25 pounds respectively—over 40% less than comparable units!

In addition to low original cost, this design substantially reduces installation and maintenance expenses. One man can carry these units up a pole and install them in a matter of minutes. The case will never rust—never need painting. Silicone-rubber bushing gaskets are impervious to Inerteen® and are not affected by extreme temperature changes.

* * *

✻ *Hamilton Brooks, Supervisory Engineer, Capacitor Section, demonstrates the light weight and easy handling characteristics of these new capacitors.*

They can be mounted with bushings either up or down—bolted to the pole or mounted on the crossarm with a standard EEI-NEMA bracket. Leads are furnished and, when required, external bushing-mounted indicating fuses can be supplied.

Utility studies have shown that the capacitor cost is often less than two-thirds the value of the transformer capacity released for new load. Reduced circuit losses and improved voltage are a bonus that may alone pay for the capacitors. The new low-cost Westinghouse secondary capacitors give added significance to these findings.

For more information on this outstanding capacitor advance, call your Westinghouse representative or write for the technical paper, *Application of Secondary Capacitors on Overhead Systems.* Westinghouse Electric Corp., 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60864

The 3 and 5-kvar capacitors are designed for use with 7-1/2 and 15-kva transformers. For maximum benefit, capacitors should be placed on the secondary runs about two-thirds of the distance from the transformer to the end of the line.

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Since the ISOLATOR is more compact than an equally rated knife blade type of switch it weighs less. Consequently, it can be mounted and installed in much less time. Furthermore, all elements, including poles, are mounted and aligned on a rigid frame in our factory. You will find them faster and easier to install.

90% of These Popular Straight-line Disconnects Now Available in 10 Days

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There are no shortcuts here . . . the ISOLATOR is solidly built, first class switchgear. It definitely saves space and is easy to install. While we offer 276 different models, 90% of all ISOLATORS sold are the 13 models in most common use. By carefully co-ordinating inventory with production we fill these orders in 10 days.

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Designing Clearances

(*Continued from page* 107)

Other Design Factors . . . Grading shields suitably designed to secure optimum clearances effect worthwhile economies in tower and line design. A total reduction of 15% in the spacing of conductors reduces the line reactance about 3% and raises the capacitance the same amount. Corona losses and radio influence are affected, but not appreciably.

Minimum midspan spacings between conductors depend on span and tower design, weather conditions and geographical location. Experience with 230-kv lines in comparable locations provides a good criterion for design. There is no good reason why minimum clearances at midspan for 288 and 345 kv should be appreciably greater than for 230 kv. Theoretically the increase in midspan clearance need not be more than the differential in voltage spacing requirement, i.e., (345-230), an amount already provided at the tower. All this assumes comparable conditions, span, etc.

In setting up design clearances at towers, designers should give special attention to transposition, anchor and angle towers.

Fast circuit breakers are definitely conducive to improved operation and economies in design. The application of rapidly reclosing breakers to remove non-permanent faults permits use of reduced clearances within the limits indicated. Hot-line maintenance imposes a need for reasonably low clearances at the higher voltages to enable men to handle their equipment efficiently and in safety.

B. C. Electric Denies Encroachment Innuendo

B. C. Electric Co has no designs on the territory of the British Columbia Power Commission, and is, in fact, its best customer.

That was the statement made by A. E. Grauer, BCE president, concerning reports that James D. W. Blyth resigned from the recently formed three-man power commission because of alleged encroachment by BCE on commission territory.

"The press has carried statements implying that James Blyth resigned from the B. C. Power Commission after having held office for six weeks

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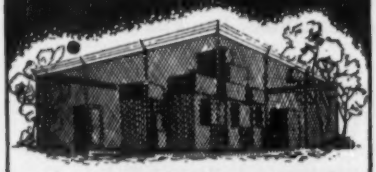

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because he feared encroachment by the B. C. Electric. At no point was Mr. Blyth quoted as saying this, but the implications were definitely to this effect," Grauer said.

"I am able to state categorically that the B. C. Electric has no such policy and has not even discussed the proposition of encroaching into territory of B. C. Power Commission. Furthermore, the record shows clearly there has been no such policy in the past. . . ."

Controversy over power development began June 9 following resignation of Power Commission member Blyth because of his "concern over the future of public power in British Columbia."

Commenting on the situation, Premier W. A. C. Bennett said that as long as he is premier, the power commission "will never be sold out entirely or in part to any private company."

Blyth is now back in Toronto with Brazilian Traction, Power & Light Co. In a telephone conversation with President Grauer of BCE, he reiterated his explanation that he resigned because "I mainly feared for the future of public power in British Columbia."

"There should be a full share for both types of power in the development taking place in British Columbia and I am pleased to hear that Premier Bennett's statement now gives that assurance unequivocably," he said.

Construction Is Started on Britain's Super-Grid

Tower construction has begun on the 114-mile section of the supergrid between Staythorpe and Elstree in England. The contract, which is being carried out by British Insulated Callender's Construction Co, involves erection of 560 towers and stringing of twin SCA conductors on each phase of the double circuit line.

Conductors have a cross sectional area of .4 sq in copper equivalent to allow for possibility of 380-kv transmission in the future and for the same reason the towers are designed for either 275-kw or 380-kv transmission. Provision is being made for an increase in number of discs on each insulator string to allow for the higher voltage.

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ELECTRICAL TESTING LABORATORIES, INC.

Electrical, mechanical, photometric, radiometric and chemical laboratories, rendering testing, research and associated services, including certification, inspections at factories and field investigations.

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ROBERT E. FOLEY CONSTRUCTION CORPORATION

Construction & Maintenance

Transmission—Distribution—Communication Lines
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GILBERT ASSOCIATES, Inc.

Engineers • Consultants • Constructors
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HOOSIER ENGINEERING COMPANY

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Engineers and Consultants

Design and Supervision of Construction
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Engineers - Constructors - Consultants

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THE ONE-STEP METHOD
(exclusive with R&S)

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Financing—Rate of Return

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PROFESSIONAL SERVICES

(Continued from page 179)

SANDERSON & PORTER

Engineers and Constructors

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SARGENT & LUNDY

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Hydraulic Engineering, Hydro-electric Development, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

50 Church Street, New York 7, N. Y.

F. A. TUCKER, INC.

Contractors—Engineers

specialize in

Distribution - Transmission - Telephone lines - Maintenance - Roads - Bridges Dams

Main Office—88½ Center Street, Rutland, Vt.
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UTILITIES LINE CONSTRUCTION COMPANY, INC.

Construction and Maintenance

Transmission - Distribution
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THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

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"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT: BUSINESS: **"OPPORTUNITIES"** :EQUIPMENT :USED OR RESALE

UNDISPLAYED —RATES— DISPLAYED

$1.35 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

POSITION WANTED, undisplayed rate is one-half of above rate, payable in advance.

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Discount of 10% if full payment is made in advance for 4 consecutive insertions.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $11.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

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SEND NEW ADVERTISEMENTS TO: 330 W. 42 St., N. Y. 36, N. Y., for July 12th issue closing July 2nd

ELECTRICIANS

who have had eight or more years Utility or Heavy Industrial experience in one or more of the following: High Voltage Switch Gear and Controls; Power Relaying and Metering; Supervisory Control Systems; High Power and Intricate Rectification Systems; Relaying and Telemetering; Power Plant and Substation Electrical Systems.

CABLE SPLICERS

who have had at least eight years experience with up to 18,000 Volts Power Cable.

Forward resume of training and experience to:

CARBIDE AND CARBON CHEMICALS COMPANY

Post Office Box 748

Paducah, Kentucky

Att: Personnel Dept.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED: ELECTRICAL Design Engineer with exceptional ability and successful experience in the design and testing of light duty electrically operated remote controlled oil filled and dry type outdoor switching devices from 120 volts to 15 KV. This is an exceptional opportunity for an engineer capable of producing simple and practical designs for low volume production. Advancement is assured and salary attractive. The position is permanent with an established small manufacturer in Indiana. Give experience, education, references, age, recent photo if available, and salary expected. P-1621, Electrical World.

DISTRIBUTION ENGINEERS — Two competent experienced graduate Electrical Engineers, with approximately 10 years' experience design, operation and maintenance of distribution facilities in established rapidly growing utility located South America. Reply giving resume education, experience and personal data. Box P-2970, Electrical World.

METER SUPERINTENDENT — Established rapidly growing utility in Brazil requires competent technician with 10 years' experience Meter Department of U. S. or large Latin American Public Utility to supervise Meter Departments several operating companies. Single man preferred as considerable traveling involved. Reply giving resume education, experience, and personal data. Box P-2971, Electrical World.

WANTED—SUPERINTENDENT for Municipal Utilities, electric water and sewer. Position now open. Write or call for additional information. Geneseo Municipal Utilities, 101 South State Street, Geneseo, Illinois.

ASK ABOUT SPECIAL PRICES FOR FAIR TIME

LOAD-BUILDING LITERATURE

Now in Stock

STUFFERS (As low as $6.25 per M, while present stock lasts)

Chick Brooding — Farm Workshop
Crop Conditioning — Feed Handling

BOOKLETS (As low as 2¢ each, while present stock lasts)

"Making Water Pay Dividends in the Dairy Barn and Milk House"

"It Takes Water to Produce Eggs and Meat"

"Planned Watering for Greater Yields in the Garden"

ALSO AVAILABLE: FULL COLOR BOOKLET ON WATER SYSTEMS AND FULL COLOR FOLDERS ON ELECTRIC RANGES, ELECTRIC HOT WATER HEATERS, ELECTRIC DRYERS, AND FREEZERS.

WISCONSIN ADVERTISING SERVICE

135 W. Wells St. Milwaukee 3, Wis.

POSITIONS VACANT

ASSISTANT PROFESSOR of Electrical Engineering University of North Dakota, Grand Forks, No. Dak. Duties: Teaching electrical power courses and some service courses to undergraduate students. Appointment to begin in Sept. 1954. An advanced degree plus some teaching or industrial experience preferred. Submit resume of education and experience to Head, Department of Electrical Engineering.

LOAD DISPATCHER: Established growing utility in one of most desirable locations in Brazil desires temporary services (about one year) of experienced technician to initiate dispatching service and train local personnel in its operation and maintenance. System is combination thermal and hydro with transmission up to 132 kv. Excellent opportunity for active retired experienced chief load dispatcher. Reply giving education, experience and personal particulars. P-2972, Electrical World.

WANTED: YOUNG energetic Electrical Engineer, graduate, experienced in construction and cost estimating of High Voltage Power Transmission Systems, for Promotion work. Activities would involve some travel out of Home Office in the midwest. Write P-3073, Electrical World, including: Age, experience, references, recent photograph, if available and salary desired.

POSITIONS WANTED

EXPERIENCED SWITCHBOARD Operator would like operating job in central or substation. PW-8267, Electrical World.

ELECTRICAL-MECHANICAL Engineer with extensive experience in administration, design and operation of industrial steam power plants, utility power plants and municipal utility systems. Desires administrative position with private utility or industrial plant. Midwest or West preferred. PW-3040, Electrical World.

WANTED

Wanted to Purchase, Work gloves, dirty, discarded. Finecraft Products Co., 175 - 5th Ave. N.Y.C.

RE-NU-BUILT
GUARANTEED
ELECTRIC POWER EQUIPMENT
MOTOR GENERATOR SETS
3 ph., 60 cy.

Qu.	KW	Make	Speed	DC Volts	DC Volts
1	3000 3U	G.E.	514	600	4000/13200
2	2000/2400	G.E.	450	250/300	2300/4600
2	2000	G.E.	514	600	6600/13200
1	2000	G.E.	500	666 25 cy.	11000
2	2000	G.E.	450	600	2300/4600
1	1500	C.W.	514	115	4000/13800
1	1500	G.E.	720	600	13200
1	1000	G.E.	900	260	4100/5900
2	1000	Whse.	900	600	2300/4150
3	1000	G.E.	720	600	2300/4600
1	750	Whse.	900	275	2300/4150
1	500	Whse.	1200	125/250	2300
1	500	Whse.	900	250	440
1	300	G.E.	720	125	2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing—425 lbs—750° F.T.T.—Surface Condenser 3/60/2300-4000 v with exciter
1	1000	G.E.	Non-Cond—190 lbs-2400-3-60
1	1000	Moore	Condensing — Extraction — 190 lbs., 2400-3-60—Surface Cond.
1	750	G.E.	Condensing—265 lbs., 440-3-60 Built 1944
1	500	Moore	Non-Cond—150/200 lbs., 5/35 lbs. B.P., 480-3-60 Dir. Conn. Exciter.
1	300	G.E.	Non-Cond—150/175 lbs., 5/10 lbs. B. P., 480-3-60

FREQUENCY CHANGERS

Qu.	Kvs	Make	Cycles	Voltages
1	13900	Whse.	60/25	13200 x 13200
1	3750	G.E.	60/25	4150/2400 x 2400/4150
1	3125	G.E.	25/60	4150/2400 x 2400/4150
2	2600	G.E.	25/62½	2300 x 4160
1	1250	G.E.	25/58.3	4400 x 2300
1	625	A.C.	25/60	11000 x 2300

TRANSFORMERS—60 Cycle

KVA	Make	Type	Ph	Voltages
1—5000	Whse.	OISC	3	33000x26400/13200
1—2500	Whse.	OISC	3	26400/13200 x 480
3—2000	G.E.	HVDDJ	1	66000 x 13800
1—1500	G.E.	HT	3	13200 x 2300
2—1250	G.E.	HVDDJ		6600/550
3—1000	G.E.	HVDDJ	1	2200/480

BELYEA COMPANY, INC.
51 Howell Street, Jersey City 6, N. J.

DIESEL POWER

IMMEDIATE SHIPMENT
- **PURCHASE OR RENTAL**

UNIT CAPACITIES—10 TO 2475 KVA
A.C.—50 AND 60 CYCLES
- **ALSO D.C. UNITS**

A PARTIAL LISTING OF OUR INVENTORY

KW	Make	Model	HP	RPM	KW	Make	Model	HP	RPM
1180	Worthington	SEH-8	1685	360	400	Ingersoll-Rand	S-8	600	720
1136	Fairbanks Morse	38D	1600	720	350	Baldwin	VO-6	510	450
1100	General Motors	16-278A	1600	720	320	Enterprise	DSG-6	560	450
750	General Motors	12-567	1080	720	300	General Motors	8-268A	450	1200
700	Worthington	EE-8	1000	327	200	General Motors	8-268A	350	900
500	General Motors	8-278A	750	720	150	Worthington	CC-4	225	450
500	General Motors	8-567	720	720	150	Ingersoll-Rand	S-4	225	600
500	Alco	6-12 x 13T	750	600	150	Buckeye	80	240	600
480	Worthington	DD-8	700	360	100	General Motors	3-268A	150	1200
400	Sterling	VDS-8	600	1200	60	General Motors	6-71	90	1200

A. G. SCHOONMAKER COMPANY, INC.
DIESEL DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

J. L. HEMPHILL & CO.
ELECTRICAL ENGINEERS & EQUIPMENT
1606 53rd St., NORTH BERGEN, N. J. N Y C Tel: LOngacre 5-3227 N. J. Tel: UNion 3-2600

TRANSFORMERS
- 2— 750 KVA G.E., 3 Ph., 4150V, 120/240V. sec.
- 2— 750 KVA G.E., 1 Ph., 4600V. 115/230
- 2— 400 KVA Pitts., 1 Ph., 2400/4800V. 240/48V.
- 3— 333 KVA Whse., 1 Ph., 2400V. 600 V. sec.
- 2— 300 KVA G.E., 1 Ph., 13200V. 220/440V.
- 1— 200 KVA G.E., 3 Ph., 2400-220 sec.
- 3— 200 KVA G.E., 1 Ph., 13200V. 440V.
- 1— 200 KVA G.E., 3 Ph., 4150V., 3 Ph. 2400V. Auto.

SYNCHRONOUS MOTORS
- 1— 300 H.P., Elec. Mach., 720 RPM, 3 Phase 60 cyc., 2200V T E F Cooled Outdoor service.
- 1— 150 H.P., G.E., 1800 RPM, 220V. 3/60.
- 2— 150 H.P., Al. Chal. 360 RPM, 440V. 3/60.

MOTOR GENERATOR SETS
- 1—1000 KW Whse., 600 V. 720 RPM. 4600 syn.
- 1—1000 KW G.E., 600 V. 514 RPM. 4000 Syn.
- 1—1000 KW Whse., 275 V. 720 RPM. 4000 Syn.
- 1— 200 KW Whse., 250V., 900 RPM. 4000V. Syn.
- 1— 150 KW G.E., 120/250V. 1200 RPM. 2300 Syn.
- 1— 100 KW G.E., 250V. 900 RPM. 2300V. Syn.

SLIP RING MOTORS
- 3— 500 H.P., G.E., M 1200 RPM 2400V.
- 1— 400 H.P., West., CW. 450 RPM. 550V.
- 1— 250 H.P., West., CW. 600 RPM. 440V.
- 1— 200 H.P., West., CW. 600 RPM. 440V.
- 3— 150 H.P., Al. Ch. 1800 RPM. 2300V., 3PH. 60 Cy.

Large Stock of A.C. and D.C. Equipment

WANTED
SURPLUS
G. E. A BASE WATTHOUR METERS
Large Quantities, Type 116 Or Later

Large quantities glass covered 114 METERS or GLASS COVERS alone.
MOTORS for M20 or M21 Demand Registers.

FOR SALE, LARGE QUANTITIES WATTHOUR METERS & WHR DEMAND METERS

TYPE MG2S, 15 A. 120/208 3 Wire 60 Cy. Network
TYPE CAH 5 & 50 A. 120/240 3 Wire 60 Cy. 1 Phase
TYPE CAH2, 5, 15, 50A. 240 3 Wire 60 Cy. 3 Phase

ALSO

100 Phasing Trans. Delta 5⌀ 4 Wire 240/240 G.E. Type MC7.
1000 Dem. Regs. G. E. Type M21P Univ. Ratio 15 min.

THE ELECTRICAL WATTHOUR METER CO.
76-15 WOODSIDE AVENUE
ELMHURST 73, N. Y.
Phone HAvemeyer 9-0131

ELECTRICAL WIRE AND CABLE

—YOUR BEST SOURCE—
- for every industrial and power application
- Add lengths—long and short—reasonably priced
- largest stock in Midwest
- varnished cambric — leaded — neoprene

Let us quote on requirements—send your inquiries

DELIVERY
QUICK . . . from stock
We'll also buy your Surplus
Branch Offices:
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UNIVERSAL Wire and Cable Co.
2860 N Clybourn Ave., Chicago 14, Ill.
EAstgate 7-4777 Code: UNIWIRE

TRANSFORMERS
FOR SALE

- 6—1000 KVA Mol 11500-2400/4160Y
- 3— 833 KVA G-E 35000—480
- 3— 500 KVA G-E 26400—240/480
- 8— 333 KVA W-H 38000-7200/12470Y
- 3— 333 KVA G-E 33000-2300/4000Y/6900/-11950Y
- 3— 333 KVA G-E 33000-2300/4000Y
- 3— 333 KVA Mol 7200/12470Y-2500/4160Y
- 3— 333 KVA W-H 6600-2300
- 3— 150 KVA G-E 44000-600/2400
- 3— 150 KVA G-E 19050/33000Y-2540/4000Y
- 5— 150 KVA G-E 7200/12470Y-240/480
- 3— 100 KVA G-E 33000-6900/11950Y
- 3— 100 KVA G-E 4000-115/230

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio
40 Years Dependable Service

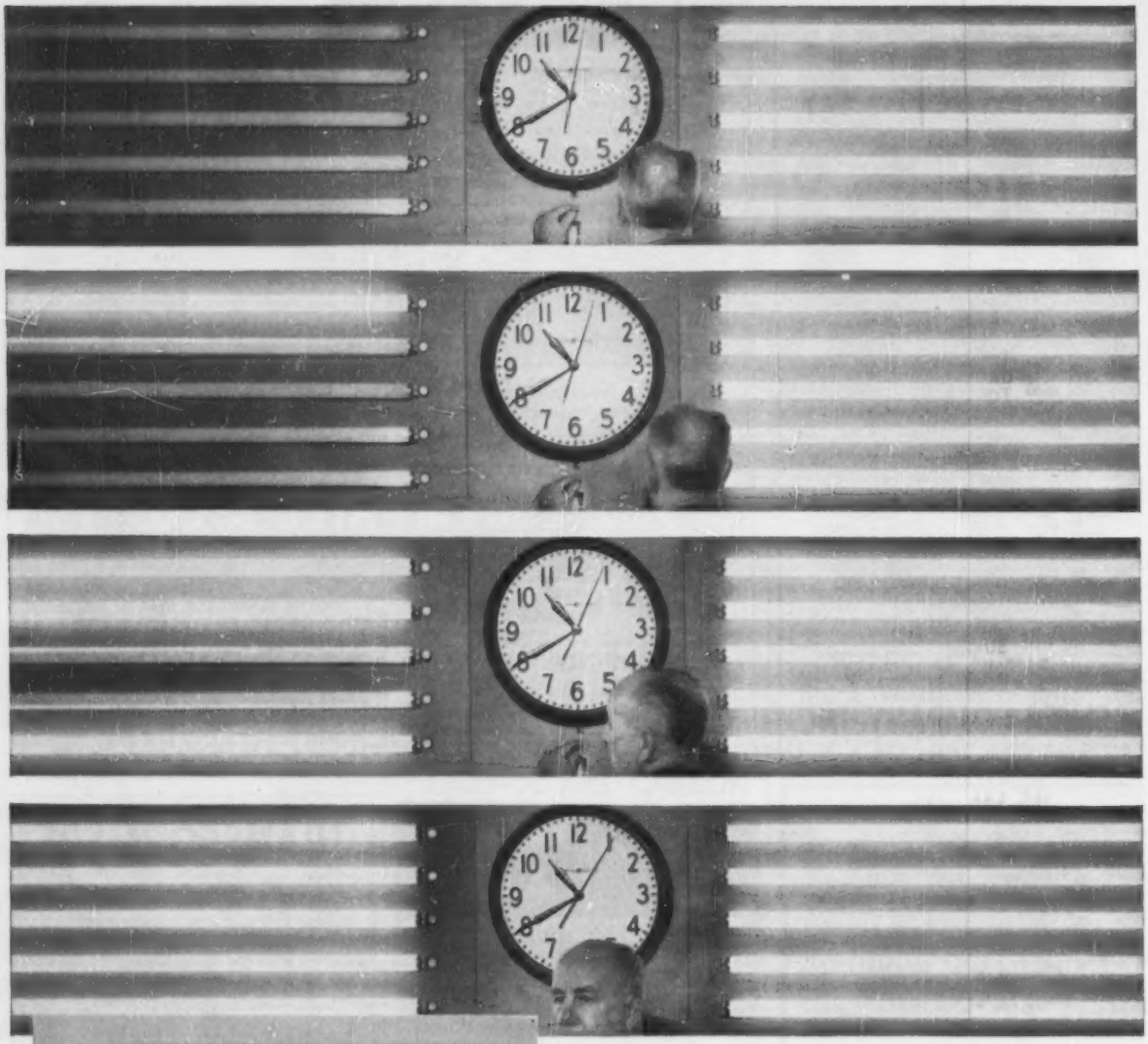
1250 HP Motors 3/60/2300 V
5—Allis Chalmers type ANW induction motors 1250 HP 3 phase 60 cy 2300 V 1180 RPM Cont. full load 40° C. Couplings attached.
Mfd. 1950 — practically new
HUGO NEU CORPORATION
31 Nassau St. Tel: REctor 2-1334, New York 5, N.Y.

TURBO GENERATOR
Available Immediately
7500 KW G. E. Co.
180 P.S.I.—625°F Total Temp.
3 phase 60 cycle 2300 volt
With Surface Condenser
GOOD CONDITION
Union Electric Co. of Missouri
315 N. 12th Blvd. St. Louis 1, Mo.

FOR SALE
Five New and Two Slightly Used 50 Kilovolt, 100 MA, G.E. Power Supplies. For Details Write
FS-2651, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE — Two Rector St., New York 6, N. Y.

YOU EXPECT THE BEST VALUE FROM G-E FLUORESCENT LAMPS



New G-E "Rapid Start" lamps light up twice as fast as others

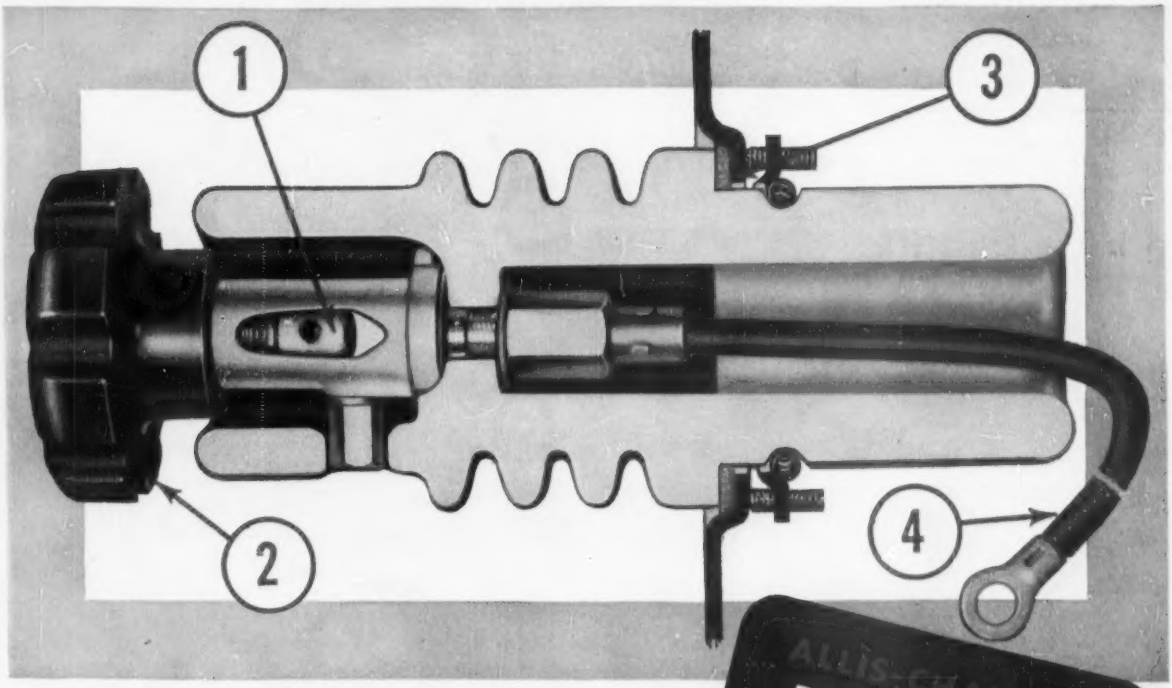
This series of pictures shows how General Electric can save you the annoyance of waiting for light.

All the lamps were started as the second hand on the clock reached zero. Within two seconds, the G-E Rapid Start lamps—right of the clock—were fully lighted. It was nearly *six* seconds before all the regular lamps, left, lit up.

G-E Rapid Start lamps eliminate the starter, cause of up to half of regular lighting maintenance troubles. They have long life, too. Reason: a triple-coil cathode that holds more starting chemical.

General Electric Rapid Starts are another example of why you can *expect* the best value from G-E fluorescent lamps. For free folder, "Facts About Rapid Start", write: General Electric, Dept. 166-EW-6, Nela Park, Cleveland, O.

GENERAL ELECTRIC



Get These HV Bushing Advantages

1 No Wire Damage! Convex surfaced ram, actuated by clamping knob, forces wires against the concave surface of connector body. Serrations on ram help grip cable securely, improving contact with conductor. This snubbing action locks the wire in the connector. The wire is not damaged in any way, since the ram cannot rotate. Two standard conductors as large as No. 2 stranded cable can be gripped simultaneously by the connector. All clamping parts are tinned for use with aluminum or copper conductors.

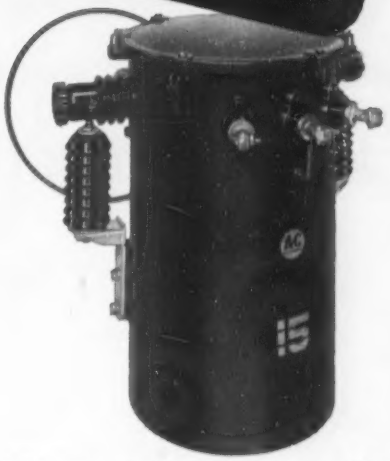
2 Improved Lineman Protection! Large molded phenolic clamping knob has collar for positive protection — fingers cannot accidentally touch "live" parts. Integral bushing electrode is recessed and gapped to lightning arrester. Gap removes electrical stress from arrester except when flashover occurs.

3 Controlled Gasket Pressure! Recessed seat in tank wall controls gasket flow for most effective seal. Internal clamping ring locks bushing in place and at the same time evenly compresses corprene gasket for effective seal.

4 Simplified Internal Connection! Bushing cable terminates at terminal board. Easy removal simplifies routine maintenance.

A-4212

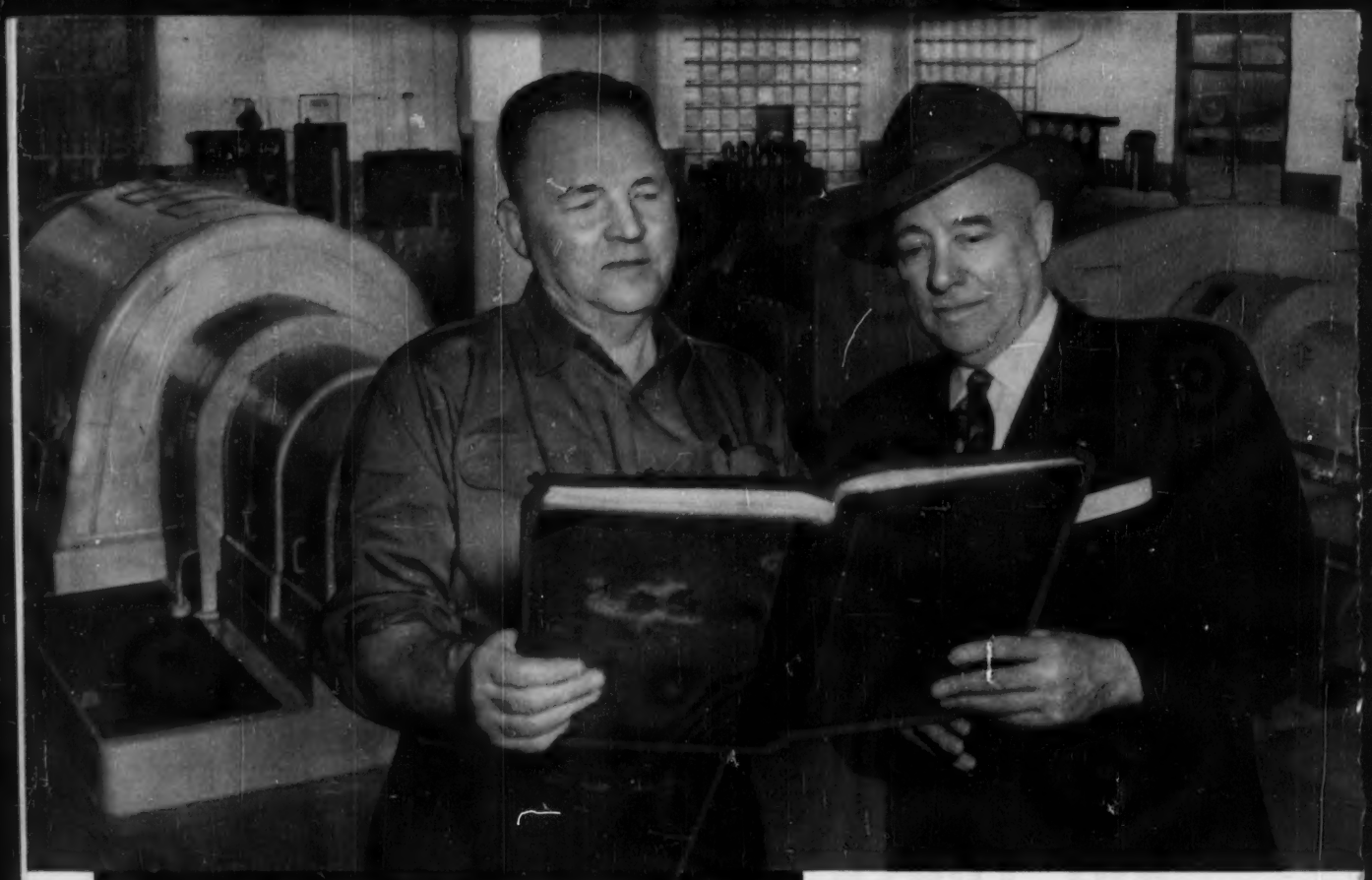
ALLIS-CHALMERS
DISTRIBUTION TRANSFORMERS

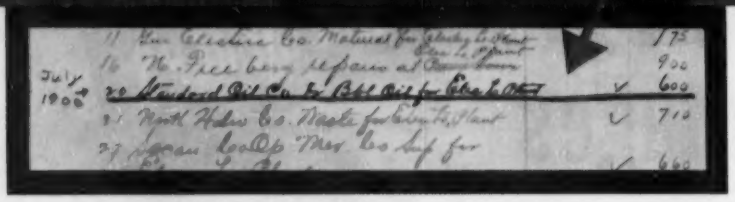


This new straight sidewall bushing is supplied on Allis-Chalmers distribution transformers 167 kva and smaller, 5 kv and below. Get complete facts from your nearby Allis-Chalmers distributor or district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS





Engineer Carl Barr and O. P. Sather, Standard Oil Chief Lubrication Engineer, are inspecting the old log book showing the first purchase from Standard Oil was made way back in 1900.

"Our records show Standard's been putting in at Two Harbors for 54 years!"

■ The operating log in the power plant of the city of Two Harbors, Minnesota, shows that on July 20, 1900, a half barrel of engine oil for use on a steam engine was the first purchase made from the Standard Oil Company. Since then, page after page of the log shows Standard has been filling all of this power plant's lubrication requirements.

Carl Barr, chief engineer for thirty years, says: "When we bought our first turbine in 1937, we knew that NONPAREIL Turbine Oil was what we wanted. NONPAREIL's performance proved that we were right. Since 1937 we've added and replaced turbines and always installed NONPAREIL. We've never had any trouble with governors. There's been no foaming or rusting . . . no deposits in the oil coolers. In fact, with NONPAREIL on the job we've had no malfunctions of any kind!"

For guaranteed lubrication in *your* turbines—new or old—fill with NONPAREIL Turbine Oil. With each fill of NONPAREIL goes a written guarantee stating that the oil will last as long as the turbine and will maintain a neutralization number below 0.15 mg. KOH/gm. Call the Standard Oil lubrication specialist near you or write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY

STANDARD (*Indiana*)